5. Runtime Environment

This chapter describes the software configuration for the COE runtime environment. All software and data, excepting low-level components of the bootstrap COE, are packaged as segments. A *segment* is a collection of one or more CSCIs (Computer Software Configuration Items) most conveniently managed as a unit. Segments are constructed to keep related CSCIs together so that functionality may be easily included or excluded.

There are six *segment types* corresponding to the different types of components that may be added to a system:

1. **COTS:** A segment totally comprised of commercial off-the-shelf software.

2. **Account Group:** A segment that serves as a template for establishing a runtime environment for individual operators.

3. **Software:** A collection of executables and static data that extend the base functionality and environment established by an account group.

4. **Data:** A segment composed of a collection of data files for use by the system or by a collection of segments.

5. **Database[1]:** A segment that is to be installed on a database server under the management of the DBMS and ownership of the DBA. A Database segment can only be installed on a database server and the installation tools enforce this. Note that a database client application segment can be installed on any workstation and usually is a software segment type.

6. **Patch:** A segment containing a correction to apply to another segment whether data or software. The corrections entail replacing one or more files.

In addition, segments may have attached characteristics, called *segment attributes*, which serve to further define and classify the segment. There are six segment attributes[2]:

1. **Aggregate:** A collection of segments grouped together and managed as an indivisible unit.

[1] Database server segments are supported only on Unix servers for this release. Database application segments may be created for either the Unix or NT environment.

[2] Subsection 5.5.33 discusses how to indicate segment attributes with the `SegName` descriptor. Segment attributes are noted by the appropriate parameter within the `$TYPE` keyword of the `SegName` descriptor. Aggregate and Parent attributes are combined into the single `AGGREGATE` parameter. The Child attribute is indicated by the `CHILD` parameter. COE Component is subdivided into the `COE CHILD` and `COE PARENT` parameters. Similarly, the Web attributed is subdivided into the `WEB APP` and `WEB SERVER` parameters. Finally, the Generic attribute is indicated by the `GENERIC` parameter.

2. **Parent:** A segment that is part of an aggregate, but is considered to be the "root" segment. The parent segment name is the name presented to an operator as the name of the aggregate. An aggregate can have only one parent segment.

3. **Child:** A segment that is part of an aggregate, but is subordinate to a single segment designated as the parent. An aggregate can have multiple child segments.

4. **COE Component:** A segment that implements functionality contained within the COE, as opposed to a mission-application segment.

5. **Web:** A segment that uses Web-based technology to create the application. A Web segment is either a Web server, or a Web-application segment (e.g., a client application). A user requires a Web browser to access Web-based segments.

6. **Generic:** A segment that is to be automatically added to all "usual" account groups (see subsection 5.4.10 below). This feature allows a segment to participate in multiple account groups without the need for the segment to explicitly name each account group.

> **Note:** The attributes listed here are often used in the vernacular as if they are segment types (discussion of an aggregate segment, a COE-component segment, a Web segment, etc.). Technically such usage is incorrect because these are *attributes* and not *types*. When discussing segments by attribute, it is implicitly understood that there is an underlying segment type, usually software.

Segment installation is accomplished in a disciplined way through instructions contained in files provided with each segment. These files are called *segment descriptor files* and are contained in a special subdirectory, `SegDescrip`, called the *segment descriptor subdirectory*. The segment descriptor files embody a technique that allows a segment to "self-describe" itself. That is, the segment descriptor files contain pertinent information describing the segment, such as the segment name and type. This information is used by other software in the COE and other segments that need to access functionality contained within the segment. But the descriptive information is also used by people to aid in the integration process, to aid in security analysis of the segment, or in configuration management. Installation tools process the segment descriptor files to create a carefully controlled approach to adding/deleting segments to/from the system. The format and contents of the segment descriptor files are the central topic of this chapter.

Principles contained in this chapter are fundamental to the successful operation of the COE and achieving DII compliance is largely determined by how well developers apply the details given in this chapter. Appendix B summarizes the compliance requirements stated in this chapter into a series of checklists organized by Category 1 compliance levels. Developers are required to adhere to the procedures described herein to ensure that segments can be installed and removed correctly and that segments do not adversely impact one another. Unless otherwise noted, all requirements apply to both Unix and NT.

Note: In this chapter and throughout the *I&RTS* mention is made of occasions when approval is required by a Chief Engineer. Unless otherwise stated, this means the DII COE Chief Engineer for COE-component segments and mission-application segments that affect interoperability. All other references refer to the Chief Engineer responsible for the mission-application segment (e.g., GCCS Chief Engineer, ECPN Chief Engineer). The Chief Engineer is not necessarily a DISA engineer, and will not be for the majority of the mission-application segments. Likewise, use of the term SSA refers to the responsible SSA unless otherwise qualified.

5.1 New and Obsolete Features

This DII COE release includes a number of improvements over previous COE releases. A list of the more significant improvements is provided here for developers who are already familiar with the JMCIS or GCCS COEs, or a previous DII COE release.

The present release is backwards compatible with previous JMCIS, GCCS, and DII COE releases. Segments presently in use do not require modification to work with the features described here. However, certain features from previous JMCIS and GCCS COE releases are now obsolete and support for them will eventually be phased out. Obsolete features are listed in a subsection below.

All of the features from the previous *I&RTS* have been preserved. Segments which have been migrated to any version of the DII COE do not require additional work to be compatible with this issue of the *I&RTS*. Compliance-level requirements have not been increased with this release, but the compliance criteria in Appendix B have been reworded and reorganized for clarity.

Periodic modifications to the DII COE and the *I&RTS* are made for several reasons:

- to address non-Unix environments,
- to allow extension to other problem domains,
- to provide support for new and emerging technologies,
- to generalize the COE concept,
- to improve site installation and administration of segments,
- to simplify or clarify certain segment descriptor files,
- to further reduce integration problems,
- to meet emerging mission requirements, and
- to apply lessons learned.

5.1.1 New Features

This subsection is broken into two parts. The first summarizes DII COE features that were not present in JMCIS or GCCS COE releases. This list is repeated from the previous *I&RTS* version and its purpose is to assist developers migrating from those two environments to the DII COE. The second summarizes new features in this release that were not present in the previous *I&RTS* release. Its purpose is to serve as a handy reference of new features for developers already using the DII COE.

Features Not in JMCIS or GCCS COE

- COE-component segments are defined and installed in a special COE directory.

- `SegInfo` contains most segment information instead of using individual segment descriptor files.

- Segment executables are stored in a `bin` subdirectory rather than a `progs` subdirectory to conform to commercial practice.
- Library modules are stored in a `lib` subdirectory rather than a `libs` subdirectory to conform to commercial practice.
- Segments may reserve space to allow room for growth.
- Segments may request space on multiple disk partitions.
- Segments may specify NFS[3] mount points.
- Segments may request system reboot after installation.
- Segments may affect the user account creation/deletion process.
- Segments may perform cleanup operations during the `MakeInstall` process.
- Segments are automatically compressed by `MakeInstall` (this can be disabled).
- `PostInstall` and other installation-related scripts may prompt operators during segment installation.
- `COEServices` is extended to include other system services.
- Icons and Menus are supported.
- Local and remote segments are supported.
- Character-based interfaces are supported.
- The COE contains a COTS license manager.
- Configuration definitions[4] are supported.

[3] NFS support is provided for the benefit of legacy systems. DFS is preferred, but few applications are ready to take advantage of DFS. Moreover, some designers may elect not to use DCE in favor of other distributed computing environments such as CORBA or DCOM/OLE. The *I&RTS* will be extended in a future release to provide direct DFS support. Segment developers may not alter the Unix `/etc/exports` file. This is set in the kernel COE or through COE-component segments created by system designers to export only those directories actually required to be NFS-mounted.

[4] *Configuration Definitions* were called *variants* in previous JMCIS/GCCS COE releases and in the previous *I&RTS*. The concept is the same, but has been extended and refined in this release. See Chapter 2 for more information.

- A `Processes` descriptor file is supported.
- `#ifdef`-style constructs are supported in segment descriptor files.
- The installation tools set Unix file permissions and owner.
- New tools and extensions are described in Appendix C.
- Segments may use a boolean "OR" to specify segment dependencies so that a dependency can be fulfilled by one or more segments.
- Segments may request temporary disk space for use during the installation process; such temporary disk space will be deleted when the installation is complete.
- A new segment type has been added to accommodate components that are to be managed by the DBMS.

New Features in this *I&RTS* Release

- Database applications are supported through SHADE. Descriptor information is provided in this chapter.
- The concept of data scope (local, global, segment, etc.) is extended to encompass database scope (e.g., unique, shared, universal).
- The draft PC-based COE from the previous *I&RTS* release has been formalized and incorporated as appropriate to this Chapter. It is further described in Chapter 6. Several new descriptors and keywords have been added to support PC NT applications.
- Support is provided to add NT registry entries (see the `Registry` segment descriptor).
- Standard NT file extensions (e.g., `.TXT`, `.EXE`, and `.BAT`) are supported for segment descriptor files.
- Web-based applications are supported and are described further in Chapter 7. Descriptor information is provided in this chapter.
- Guidance and support for DCE applications is provided. DCE-based applications are described further in Chapter 8. A new `DCEDescrip` descriptor and several new keywords are provided to describe DCE servers.[5]

[5] In this *I&RTS* release, DCE servers are available on Unix platforms only. DCE client applications may be on Unix or NT platforms.

- The `$KEY` keyword is added to enforce certain requests (such as installation with "root" privileges) that require Chief Engineer approval.

- The location for shared libraries is now specified (i.e., in the segment's `bin` subdirectory).

- Child components in an aggregate may now have a conditional load attribute. This is described more fully below, but it allows a child segment to be loaded only if it represents a newer version than what is already on disk.

- The concept of a generic segment is added. A generic segment is automatically made a member of every account group, except those which are character-interface-based. The segment may also specify account groups that it is to be excluded from.

- Support is added for three new types of processes: RunOnce, Privileged, and Periodic. Privileged is available for Unix only, but the other two are available for both Unix and NT. RunOnce processes are executed the first time the system is rebooted, but not thereafter. Privileged processes are those which require "root" permissions to execute. Periodic processes are the Unix equivalent of `cron` processes, permitting a segment process to be run at specified intervals.

- Support is added to allow site installers to temporarily install a segment to test it.

- Support is provided to allow site administrators to create application servers that contain software for multiple platform types. Support is included for "dynamic loading" of segments.

- Segments may add executables to run during the user profile creation/deletion just as with the account creation/deletion process. Support is also added to allow executables to be run when a profile switch is performed.

- The segment installer tool, `COEInstaller`, issues a warning to the operator performing the installation if an attempt is made to load a segment that is an earlier version of one that is already on the disk.

- The `COEInstaller` tool maintains a status log of segments as they are loaded and provides the ability to print the status log. The status log may also include output from scripts (such as `PostInstall`) that is normally sent to `stdout` or `stderr`.

- A `$EQUIV` keyword has been added to the `SegName` descriptor. In effect, this allows a segment to be known by an alias.

- The `Help` descriptor has been added as a placeholder for future expansion. Its purpose is to identify "help files" within the segment and their format (Unix man page, HTML, etc.).

5.1.2 Obsolete Features

The features listed below are being phased out because changes were required to extend the DII COE to address the Joint community, to address problem domains other than command and control, and to extend to non-Unix platforms. The previous release of the *I&RTS* indicated most of these items as obsolete. They are collected here as a ready reference. This release adds only one new requirement: usage of the `$KEY` keyword. This keyword is used in instances where the *I&RTS* requires Chief Engineer authorization for some requested feature, such as permission to create a COE-component segment. To preserve backwards compatibility for existing features, `VerifySeg` only issues a warning if the `$KEY` keyword is missing. An error is generated when the `$KEY` keyword is missing for new features. Developers should begin using the `$KEY` keyword in all appropriate places because a future release will issue errors instead of warnings.

Support is still provided for each of the obsolete items listed below, but documentation for them has been removed from this release of the *I&RTS*. Segment developers and program managers should upgrade[6] to the latest DII COE to ensure future compatibility. Support for the obsolete features may be removed from the next release. The tool `VerifySeg` will issue warnings when run against old segments to identify obsolete features.

- The `MACHINE` environment variable is now obsolete. The `MACHINE_OS` and `MACHINE_CPU` environment variables should be used instead. Segment developers should not depend upon `MACHINE` being defined.

- Individual segment descriptor files are now obsolete. The `SegInfo` descriptor file should be used instead. It is divided into sections which correspond to the earlier individual descriptor files. Conversion to `SegInfo` is required for Level 8 compliance.

- Releases of the JMCIS and GCCS COEs allowed several path-related environment variables to be defined in the environment extension file. This is discouraged in order to reduce the size of the environment variable space, which is a scare system resource. Level 8 Compliance limits segments to a single path-related environment variable.

- Subdirectories `progs` and `libs` are now obsolete. Subdirectories `bin` and `lib` should be used in order to conform to conventional practice.

[6] The obsolete features are primarily in the content and format of the descriptor files and should not require any source code changes. The effort required to upgrade should be a matter of editing the segment descriptor files and running `VerifySeg`. A tool, `ConvertSeg`, described in Appendix C is available to automate the conversion to the extent possible.

- The old format of the `Data` descriptor file is obsolete. The size required is now specified in the `Hardware` descriptor instead of the `Data` descriptor. Level 8 compliance requires uses of the new format.

- Previous versions of the COE allowed `DEINSTALL`, `PostInstall`, and `PreInstall` to run with root privileges. This capability is no longer the default. The `$ROOT` keyword *must* be used instead and Chief Engineer approval is required to run with root privileges.

- Previous releases of the COE allowed a `$PATH` keyword in the `Menus` and `ReqrdScripts` descriptors. This is now obsolete since the *I&RTS* specifies the location of where files must be located relative to the segment's home directory.

- Segment descriptors `ModName` and `ModVerify` have been replaced with `SegName` and `SegCheckSum` respectively. The `SegType` descriptor file has also been replaced by the `SegName` descriptor file.

- In earlier releases, the parent segment for a child had to be listed in the `Requires` descriptor. This is no longer required because by virtue of naming the aggregate parent in `SegName`, there is an implied dependency. Child segments use the `$PARENT` keyword to explicitly name the aggregate parent. The parent uses the `$CHILD` keyword to explicitly name the children in the aggregate.

- The `$COMPONENT` keyword is now obsolete and is replaced by the `$CHILD` keyword.

- Previous COE releases automatically provided a system menu bar. Applications must now use the Executive Manager APIs to explicitly request a system menu bar.

5.2 Disk Directory Layout

This subsection describes the COE approach for a standardized disk directory structure for all segments. A standardized approach is required to prevent two segments from overwriting the same file, creating two different files with the same name, or similar issues that frequently cause integration problems. Unfortunately, such problems are often not discovered until the system is operational in the field.

In the COE approach, each segment is assigned its own unique, self-contained subdirectory. This subdirectory is called the segment's *assigned directory* or the segment's *home directory*. The segment's assigned directory is established at segment registration time. It obviously must be unique among all segments that are installed in an operational system. A segment is not allowed to directly modify any file or resource it doesn't "own" - that is, outside its assigned directory. Files outside a segment's assigned directory are called *community files*. COE tools coordinate modification of all community files at installation time, while APIs to the segments which own the data are used at runtime.

Figure 5-1 shows the COE directory structure. The root-level directory for the COE is `/h`. Underneath `/h`, disk space is organized into the following categories (note the close parallel to segment types):

COTS	segment descriptors for installed COTS products
AcctGrps	templates for establishing a runtime environment context
COE	component segments constituting the COE
data	subdirectory for shared (local and global) data files
Web	subdirectory for Web-application segments
Segments	one or more subdirectories for mission-application or other segments
USERS	operator home directories with operator-specific items such as preferences
TOOLS	collection of useful tools for the development environment

Web-application segments are collected into their own subdirectory to segregate them from all other types of applications. This is to make it easier to identify and control them from a site-administration[7] perspective. The Web-server segment is a COE-component segment and therefore is located under the `COE` subdirectory. Web-application segments may or may not also be COE-component segments, but they are placed under the `Web`

[7] Web servers and mission-application segments will likely be placed behind a firewall to administratively restrict platforms that outside users can gain access to.

subdirectory in either case. If they are also COE-component segments, the specialized processing performed for all other COE-component segments is done as well. The installation tools automatically place Web segments in their proper location.

Figure 5-1 does not show other important disk directories, such as the Unix `/etc` directory. The `/etc` directory is one of a family of related directories which contain Unix system files. Other COTS products may require specific directories as well, and there are other important system directories that are specified to each operating system.

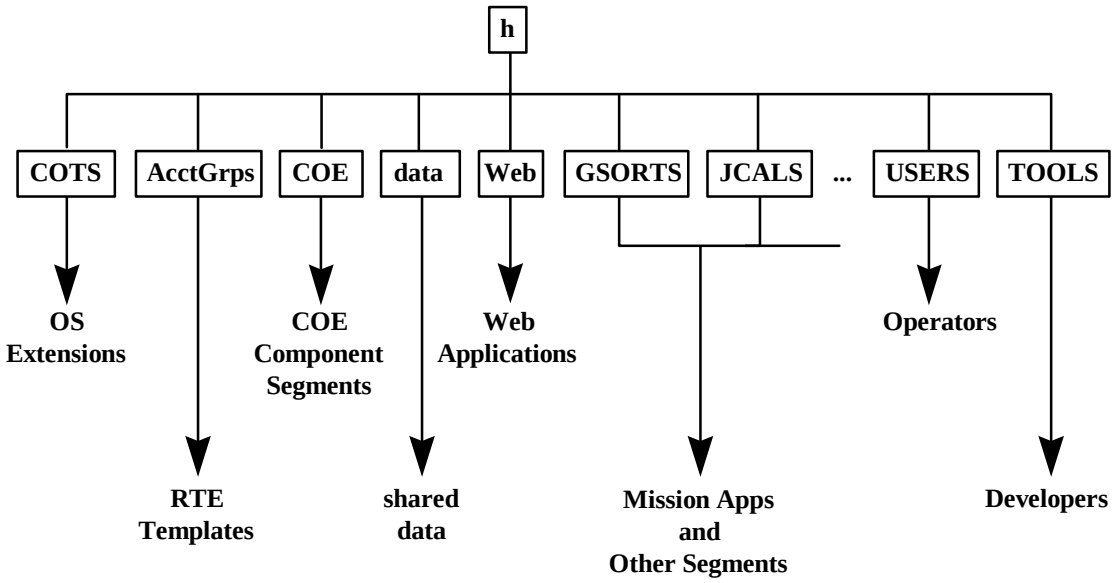


Figure 5-1: DII COE Directory Structure

Developers may *not* directly alter or create files outside of their assigned segment directory. DII compliance mandates strict adherence to this directive, with the following exceptions:

1. Temporary files may be placed in the operating system temporary[8] directory. For Unix, this is the directory pointed to by `TMPDIR` (typically `/tmp`). For NT, use the applicable Windows API to locate the temporary directory. However, disk space is limited so developers must use this temporary directory sparingly and shall delete temporary files when an application is done.

2. Segments may place data files in the `/h/data` directory, and are required to do so for shared data (see subsection 5.4.4 below).

[8] For Unix, the COE deletes all files in the temporary directory when the system is rebooted. This does *not* occur for NT system. Developers should make it a habit to delete all temporary files when they are finished and not rely upon the operating environment to delete them. This will ease porting problems and is a matter of good programming practice.

3. Operator-specific data files shall be placed in subdirectories underneath `/h/USERS` (see subsection 5.2.2 below).

4. Files may be added to the `/h/TOOLS` directory. This is a community directory for tools useful in the development process. Segments shall not place any files in this directory which are required at runtime since this directory is not installed at operational sites. This directory is described in subsection 5.2.3.

5. Segments may request that the COE tools modify community files during the installation process.

6. Segments may issue a request to modify a file to the segment which "owns" the file. This shall be done through use of, and only through use of, published APIs.

As software is loaded onto the system, the `/h` disk partition may eventually run out of disk space. The COE installation software will automatically create a symbolic link[9] to preserve the logical structure shown in Figure 5-1, and delete the link when segments are removed. Hence, Figure 5-1 represents a *logical* view, not a *physical* view, of file and directory locations. Due to the potential need to relocate segments at installation time based on available disk space, DII-compliant segments must meet the following requirements:

- Segments shall use relative pathnames instead of absolute pathnames.

- Segments which use symbolic links to point to files contained within the segment shall use relative pathnames for the link.

- Segments which use symbolic links to community files may use absolute pathnames as long as (a) the segment can determine the community file's location at install time and (b) the segment can resolve linking to a community file which may itself be a symbolic link.

- (Unix) Segments which add an environment variable to the account group's global runtime environment for locating files within the segment shall use a single "home" environment variable. Environment variables of this nature are normally required only when the segment files are to be accessible by other segments. Addition of the "home" environment variable is done by the segment installer through use of extension files and must *not* be done directly by the segment.

To illustrate the last requirement, consider a segment that provides a continuous readout of time-until-impact for a missile. Assume the segment's assigned directory is `MissleTDA` and it's segment prefix is `MSLE`. The `ReqrdScripts` descriptor file (see below) is used to add the following to the account group's `.cshrc` file:

[9] Symbolic links are called *shortcuts* in NT.

```
setenv MSLE_HOME     /h/MissleTDA
```

MSLE_HOME is called the segment's *home environment variable*. Static data within the segment can be referenced by $MSLE_HOME/data while executables may be referenced by $MSLE_HOME/bin. This technique of using relative pathnames means that segments can be easily relocated at development, integration, or installation time by modifying a single environment variable.

The last requirement stated above does not apply to environment variables defined for use purely within the software development environment. The COE requires that the runtime environment be separated from the development environment. This is typically done by separating environment variables and other settings into physically separate files. The development environment is not present during runtime for the operational system.

Also carefully note that the last requirement stated above applies only to the account group's *global* runtime environment, not a *local* runtime environment. When a segment executable is launched, it inherits the environment established by the account group template. It may then add to its local runtime environment through techniques equivalent to the C putenv() function.

The time-to-impact example illustrates additional COE requirements regarding definition of a home environment variable.

- A segment home environment variable shall point to the segment's assigned directory, *not* a lower level subdirectory (e.g., point to the directory /h/MissleTDA and *not* to the directory /h/MissleTDA/Scripts).

- (Unix) A segment home environment variable, if added to the global environment, shall be added through an environment extension file (see ReqrdScripts below).

- If a segment home environment variable is required, it shall be named *segprefix*_HOME, where *segprefix* is the segment prefix. Segments which use the same segment prefix must ensure that only one segment defines a home environment variable. This requirement assures that home environment variables are uniquely named between segments.

- Segments shall not define a global environment variable that can be derived from an already-defined environment variable. For example,

  ```
  setenv MSL_DATA        $MSL_HOME/data
  ```

  is redundant and is therefore not allowed because the expression $MSL_HOME/data can be used wherever $MSL_DATA can be used.

- Segments shall not use the "~" character (or NT equivalent) to specify relative pathnames in the runtime environment, whether to define a home environment variable or any other environment variable.

Unix allows statements of the form

```
source ~/Scripts/.cshrc.tst
```

in `.cshrc`, `.login`, and similar scripts. The "~" character is substituted at run time with the name of the home login directory (as defined in the `/etc/passwd` file). Suppose this statement were contained in a `.cshrc` file and, to prevent making duplicate copies and managing updates to this file, another segment wishes to use the Unix `source` command to include this `.cshrc` file in its own environment. Any segment wishing to source the example `.cshrc` file must duplicate the same disk directory path structure (e.g., must have a `Scripts` subdirectory underneath the home login directory) and must have a file called `.cshrc.tst` underneath the `Scripts` subdirectory. This approach is problematic in the runtime environment because the login home directory is different for every operator, and leads to difficulties in sharing environment settings.

> **Note:** Developers should minimize the use of environment variables whenever possible. The amount of memory the operating system makes available to store environment variables is limited and is therefore a scare system resource. Also, developers should bear in mind that environment variables with shorter names require less memory to store than environment variables with longer names.

5.2.1 Segment Subdirectories

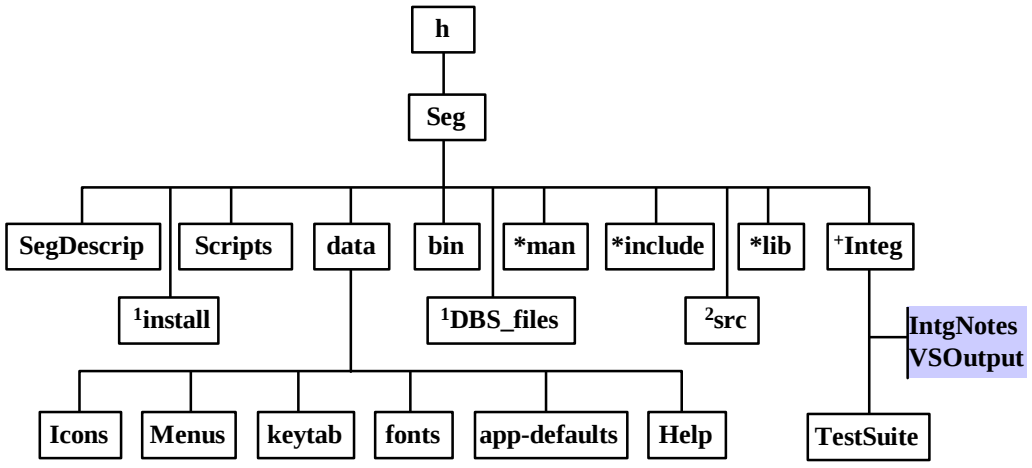
DII compliance mandates specific subdirectories and files underneath a segment directory. These are shown in Figure 5-2 for a general segment. The precise subdirectories and files required depend upon the segment type. For example, a `Scripts` subdirectory is required for account group segments. The `Scripts` subdirectory on a Unix system will normally contain, as a minimum, `.cshrc` and `.login` scripts. These serve as a template for establishing a basic runtime environment. For software segments, the `Scripts` subdirectory contains environment extension files.

Some of the subdirectories shown in Figure 5-2 are required only for segment submission and are not delivered to an operational site. Runtime subdirectories normally required are as follows:

`data`	subdirectory for static data items, such as menu items or help files, that are unique to the segment but will be the same for all users on all workstations
`bin`	executable programs for the segment

`Scripts` directory containing script files (This is usually not required for NT platforms but, if required, the directory contains "batch" files.)

`SegDescrip` directory containing segment descriptor files.



*** Required for segments with published APIs**
+ Required for segment submission
1 For Database segments only
2 Recommended location for source code during development, Required location for source code delivered to DISA.

Figure 5-2: Segment Directory Structure

The descriptor directory `SegDescrip` is *always* required for *every* segment. Its contents are defined in later subsections. Segment developers may use arbitrary disk file structures during the development phase, but segments shall conform to the structure shown prior to submitting a segment to DISA. It is a violation of the COE to use a different subdirectory name to fulfill the same purpose as any subdirectory shown as a required subdirectory, or to use a different runtime directory structure than that shown in Figure 5-2.

For example, the subdirectory `src` is a recommended directory for the location of source code during software development. Developers are free to use this name, or any other structure convenient for their development practices. They *must*, however, use this directory name for source code delivered to the DISA SSA. `bin` is a required subdirectory and shall not be used for any purpose other than that stated in the *I&RTS*.

The distinction between the `Scripts` subdirectory and the `bin` subdirectory is subtle. Files in the `Scripts` subdirectory are used to establish attributes of the runtime environment. Scripts are used here in the sense of traditional Unix, X Windows, or Motif files (`.cshrc`, `.login`, etc.) that are usually referred to only during the login process or in the establishment of a separate runtime session. Files of this nature are located in the

`Scripts` subdirectory. Executable files may be created as a result of compiling a program or may be written as a shell. Files of this nature implement executable features of the segment and are located in the `bin` subdirectory.

Subdirectories `install` and `DBS_files` are only used for database segments. Their use is described below in subsection 5.4.5

Subdirectories underneath `data` depend upon whether or not the segment has menu or icon files, uses DCE (subdirectory `keytab`), or needs additional fonts or app-defaults. During segment installation (for Unix platforms) special processing is performed on files within the `app-defaults` and `fonts` subdirectories. See subsection 5.4.4 below for more details.

The remaining subdirectories shown in Figure 5-2, except for `src`, are required in order to submit a segment to DISA as follows:

`include` subdirectory containing C/C++ header files or Ada package definition files for public APIs

`lib` subdirectory containing object code libraries for public APIs

`man` subdirectory containing Unix "man" pages for public APIs

`Integ` subdirectory containing items required in the integration process

Segments which do not contain public APIs need not submit `include`, `lib`, or `man` subdirectories. For those segments with public APIs, private APIs are not allowed in the `include` subdirectory, nor are private libraries allowed in the `lib` subdirectory.

The `Integ` subdirectory serves as a convenient repository for information that needs to be communicated from the developer to the integrator. The file `VSOutput` is *required* for all segments submitted. The subdirectory `TestSuite` is *required* for all segments which submit public APIs and is to contain source code for a program(s) which exercises all APIs submitted. The file `IntgNotes` is *required* for all segments submitted and contains a brief description of why the segment is being submitted (new features, bug fixes, etc.). It also contains any special instructions that need to be communicated to the integrator for proper segment integration and installation.

5.2.2 USERS Subdirectories

The COE establishes individual operator login accounts and provides a separate subdirectory on the disk for storing operator-specific data items. The structure underneath this directory is created and managed automatically as accounts are added and deleted by the Security Administrator software. Developers who require access to any file maintained here (last profile selected, location of operator preferences files, etc.) shall use COE-provided APIs to access them and not rely upon a particular directory or file structure.

All users with valid accounts will have a subdirectory underneath /h/USERS. The subdirectory name will have the same name as the login account name. As shown in Figure 5-3, operator accounts may be global or local in scope. A *local* account is workstation-specific, whereas *global* accounts are available from any workstation on the LAN.

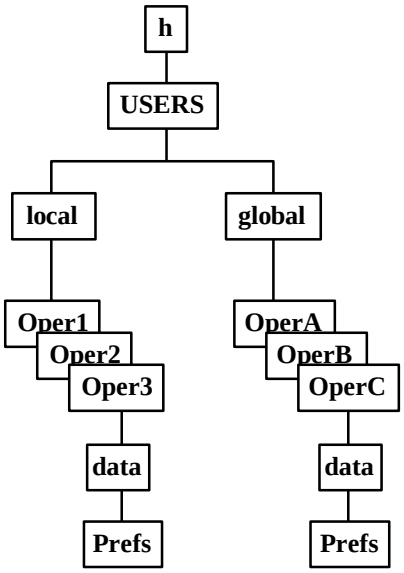


Figure 5-3: Operator Directory Structure

The subdirectory Prefs underneath the operator's data directory is used to store segment-specific operator preferences. DII compliance requires that segments store all operator preference data here. A segment is responsible for creating its own subdirectory (with the same name as the segment's assigned directory) and any required files when the segment first references the preferences data. The exact pathname for the Prefs subdirectory will change each time a different operator logs in, thus segment software shall use functions from the *Preferences Toolkit* APIs to retrieve the correct pathname for the currently active operator account.

Account group segments define the environment variables USER_HOME and USER_DATA to point to the correct operator directories. For the example in Figure 5-3, the following assignments would be made when the user whose login account name is OperA logs in:

```
USER_HOME = /h/USERS/global/OperA
USER_DATA = /h/USERS/global/OperA/data
```

Note that USER_HOME is *not* defined to be /h/USERS/global/OperA/Scripts which is the login home directory.

Segments, such as the Executive Manager, may need to reference menu and icon files for the operator's currently-defined profile. However, the directory location for these files is

profile-dependent and will change during a login session if the operator changes profiles. Segments must use functions contained in the *Preferences Toolkit* APIs to determine the current profile. The environment variable `USER_PROFILE` is set by the account group segment during login, but segments must use APIs from the *Preferences Toolkit* to access files or directories related to individual operators, or to determine the current user profile.

DII compliance requires adherence to the following:

- Segments shall create subdirectories as needed under the operator's `Prefs` subdirectory for storing operator-specific data.

- Segments must work in an environment in which accounts are created and deleted. This requires that a segment create and initialize missing operator-specific data files.

- Account group segments shall set the environment variables `USER_HOME`, `USER_DATA`, and `USER_PROFILE`. (See footnote below. Account groups must still set `USER_PROFILE` in the interim to support legacy usage.) No other segment shall set or alter these environment variables.

- Segments shall determine the operator's directory and profile exclusively through the *Preferences Toolkit* APIs or the environment variables `USER_HOME`, `USER_DATA`, and `USER_PROFILE`.[10]

5.2.3 Developer Subdirectories

Software for the runtime environment is obtained by loading the desired mission-application segments and the required COE components. But the development environment is provided separately as a Developer's Toolkit because it is not delivered to, nor required at, an operational site. The Developer's Toolkit includes object code libraries, header files which define the public APIs, and various tools. By convention, tools are loaded underneath the `/h/TOOLS` subdirectory shown in Figure 5-1. This serves as a convenient directory for software contributed by the community for general development use.

5.2.4 Test Installation Subdirectories

The COE provides the ability for sites to temporarily install a segment on a workstation to test it before putting it on other workstations on the LAN. This is accomplished by the `COETestInstall` tool, while removal of the test segment is accomplished by the `COETestRemove` tool (see Appendix C). These tools create temporary directories for storing the test segment and, if the segment already exists, `COETestInstall` moves the old segment to a safe location so that it can be restored by `COETestRemove` once

[10] `USER_PROFILE` is preserved for backwards compatibility only. The COE allows there to be multiple active profiles so that an environment variable may not be the most appropriate way to determine the current user profile. Developers must not directly access this environment variable because its use may be phased out in a future release.

the test is completed. Developers do not need to do anything special to their segment to enable this capability. It is handled automatically by the tools.

5.2.5 Application-Server Subdirectories

To assist site administrators, the COE provides support for creating application servers.[11] This is done by the tools `COECreateAS`, `COEConnectAS`, and `COERemoveAS` (see Appendix C). The `COECreateAS` tool allows segments to be loaded onto a workstation that is to be configured as an application server. The application server may contain segments for mixed hardware types (e.g., HP, Solaris, DEC, IBM, SGI). Figure 5-4 shows the directory structure maintained on the application server.

The tool `COERemoveAS` removes segments from an application sever. The tool `COEConnectAS` connects a client workstation to an application sever. It also allows "dynamic" loading of segments as explained in Appendix C.

The COE does *not* support installation of multiple versions on the application server, for the same platform and operating system version. This could otherwise lead to problems if two different versions of a segment for the same platform type were executed at the same time. Temporary testing of a new segment version must be performed using the `COETestInstall` and `COETestRemove` tools described in subsection 5.2.4

Developers do not need to do anything special to their segments to enable the application-server capability. It is handled automatically by the tools.

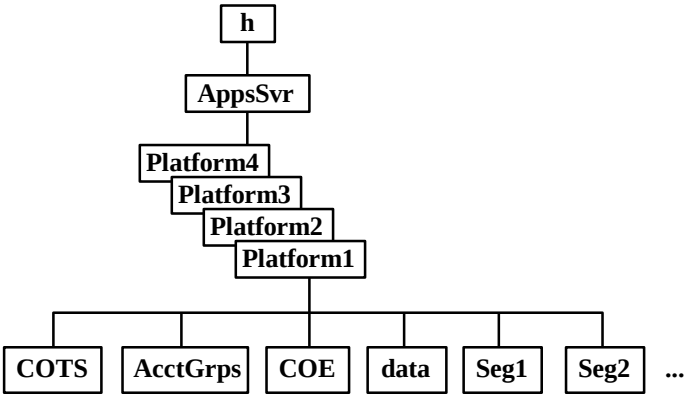


Figure 5-4: Applications Server

[11] Application servers are supported for Unix platforms *only* in this *I&RTS* release.

5.3 Segment Prefixes and Reserved Symbols

Each segment is assigned a unique subdirectory underneath `/h` called the *segment's assigned directory*. The assigned directory serves to uniquely identify each segment, but it is too cumbersome for use in naming public symbols. Therefore, each segment is also assigned a 1-6 character alphanumeric string called the *segment prefix*. The segment prefix is used for naming environment variables and things such as public APIs and public libraries where naming conflicts with other segments must be avoided. All segments shall prefix their environment variables with *`segprefix`*`_` where *segprefix* is the segment's assigned prefix. For example, the Security Administrator account group segment is assigned the segment prefix `SSO`. All environment variables for this segment are therefore prefixed with the string "`SSO_`".

The segment prefix is also used to uniquely name executables and shared libraries. All COE-component segments shall use the segment prefix to name executables and it is strongly recommended that all segments follow the same convention. For example, a proper executable for the Security Administrator account group is `SSOSetClassif`. A properly named shared library would be `SSOSampleLib.lib`. This approach simplifies the task of determining the files that go with each segment and reduces the probability of naming conflicts.

> **Note:** Use the segment prefix inside application code in situations where it is important to distinguish one segment from another. For example, when audit information is written to the security audit log, the segment prefix is also written to the audit log to allow determination of which application module generated the audited event. The same advice applies to all audit logs, including those maintained by the operating system or a DBMS.

It is sometimes convenient for segments to share the same segment prefix. This is true for aggregate segments or for segments produced by the same contractor. The COE allows segments to share the same segment prefix; however, the burden for avoiding naming conflicts is placed on the segment developer.

> **Note:** This means that segment prefixes are not guaranteed to be unique and therefore cannot be used to uniquely identify a segment. Each segment shall have a uniquely assigned directory and segment name. Therefore, the name or directory in combination can be used to uniquely identify a segment. There are situations where it is more convenient to specify a segment's assigned directory rather than its name, such as in `COEFindSeg`, because the directory name is typically shorter than the segment name and this fact can be useful in speeding up character string comparisons in segment searches. Furthermore, because the segment directory will not have embedded blanks but the segment name may, the segment name will not necessarily be the same as the assigned directory name.

The segment prefixes shown in Table 5-1 below are reserved.

Segment Prefix	Usage
CBIF	Character-Based I/F account group segment
CDE	Common Desktop Environment segment
COE	Common Operating Environment segment
DBA	Database Administrator account group segment
DCE	Distributed computing environment segment
DII	Defense Information Infrastructure segment
ECEDI	Electronic Commerce/Electronic Data Interchange segment
ECPN	Electronic Commerce Processing Node segment
EM	Executive Manager segment
GCCS	Global Command and Control System segment
GCSS	Global Command Support System segment
INFRMX	Informix COTS segment
JCALS	Joint Computer-Aided Acquisition and Logistics Support segment
JMCIS	Joint Maritime Command Information System segment
JMTK	Joint Mapping Toolkit segment
MOTIF	Motif
NIPS	Navy NIPS segment
NT	Generic NT segment
ORACLE	Oracle COTS segment
OSS	Navy OSS segment
SA	System Administrator account group segment
SCO	SCO-Unix segment
SSO	Security Administrator account group segment
SYBASE	Sybase COTS segment
TIMS	Navy TIMS segment
UB	Navy Unified Build segment
UNIX	Unix operating system
USER	prefix for operator-specific items
WIN	generic Windows segment
WIN95	Windows 95 segment
WINNT	Windows NT segment for 80x86 platforms
XWIN	X Windows

Table 5-1: Reserved Segment Prefixes

The COE sets five environment variables that must not be confused with the USER prefix or the segment home environment variable.

- The HOME environment variable is set by the operating system to be the login directory; that is, the login directory as contained in the Unix /etc/passwd file. This will normally point to a Scripts subdirectory while the segment "home" environment variable (*segprefix*_HOME) is one level up from HOME.

- The USER environment variable is set by the operating system to be the login account name and does not refer to a directory as does the USER prefix. Thus, USER_HOME will be /h/USERS/$USER.

- The environment variables LOG_NAME, LOGNAME, and LOGIN_NAME are equivalent to the USER environment variable[12], but are not always present on every system.

The COE also includes a number of predefined environment variables that are required by Unix, NT, X Windows, and other COTS software. These environment variables are either set automatically by the operating system or they must be set by an account group segment. Other segments shall not alter these environment variables except as permitted by environment extension files (e.g., extending the path environment variable).

Table 5-2 below lists various important environment variables that is set by the applicable account group, the parent COE-component segment, or the COE installation tools.

The COE sets environment variables MACHINE_CPU and MACHINE_OS to define the hardware and operating system being used. This allows scripts and descriptors to perform operations that are dependent on the hardware or operating system. Table 5-3[13] below lists the possible values set by the COE which either may be used as constants in #ifdef constructs within descriptor files or as possible values for the appropriate environment variable (e.g., MACHINE_CPU).

Note that the environment variables (e.g., MACHINE_CPU) will have one and only one value, but several constants may be defined for use within the descriptor files. For example, if the hardware platform is an HP715 running HP-UX 9.01, the MACHINE_CPU environment variable will be set to HP715, MACHINE_OS will be set to HPUX, while the constants HP, HP715, HPUX will be defined for use in descriptors.

[12] USER is preserved for backwards compatibility with legacy pre-POSIX systems. LOGNAME is the proper POSIX equivalent.

[13] This list of constants will be updated as new platforms are supported. Refer to the *DII COE Release Notes* and *Version Description* documents for details as new platforms are supported.

Environment Variable	Usage
COE_SYS_NAME	string containing system name (e.g., "GCCS")
+COE_TMPSPACE	location of temporary space
*DATA_DIR	/h/data
DISPLAY	current display surface (Unix only)
HOME	user's login directory
+INSTALL_DIR	absolute pathname to where segment was installed
*LD_LIBRARY_PATH	default location of shared X and Motif libraries (Unix only)
*LOGNAME	user's login account name
*LOG_NAME	user's login account name
*LOGIN_NAME	user's login account name
*MACHINE_CPU	CPU type derived from uname -m
*MACHINE_OS	Operating system derived from uname -s -r
path	list of paths to search to find an executable
SHELL	shell used (e.g., /bin/csh) (Unix only)
+SYSTEM_ROOT	absolute pathname to where Windows is installed (applicable to PC-based COE only)
TERM	terminal type (Unix only)
*TMPDIR	location of the system-defined temporary directory
*TZ	time zone information (Unix only)
USER	user's login account name
USER_DATA	user's data directory under /h/USERS/local or /h/USERS/global
USER_HOME	user's home directory under /h/USERS/local or /h/USERS/global
USER_PROFILE	user's current profile under /h/USERS/local/Profiles or /h/USERS/global/Profiles
*XAPPLRESDIR	/h/data/app-defaults (Unix only)
*XENVIRONMENT	/h/data/app-defaults/COEBaseEnv (Unix only)
*XFONTSDIR	/h/data/fonts (Unix only)

Legend: * Environment variables set by the parent COE-component segment.

+ Environment variables set by the COE installation tools. These are defined only at installation time.

All remaining environment variables are set by the applicable account group segment.

Table 5-2: COE-Related Environment Variables

MACHINE_CPU Environment Variable	
Constant	**Platforms for Which Defined**
HP700	HP 700 series workstations
HP712	HP712 workstations
HP715	HP 715 workstations
HP750	HP 750 workstations
HP755	HP 755 workstations
PC386	Intel 80386 workstations
PC486	Intel 80486 workstations
PENTIUM	Intel Pentium workstations
SPARC	Sun Sparc workstations
SUN4	Sun 4 workstations

MACHINE_OS Environment Variable	
Constant	**Platforms for Which Defined**
HPUX	all HP-UX workstations
NT	all NT workstations
SOL	all Solaris workstations
WIN95	all Windows 95 platforms

Miscellaneous Constants	
Constant	**Platform for Which Defined**
HP	all HP platforms, regardless of OS
PC	all 80x86 platforms, regardless of OS
SPARC	all Sun Sparc workstations, regardless of OS

Table 5-3: Platform and Operating System Constants

5.4 Segment Types and Attributes

Segment types and attributes were briefly introduced at the beginning of this chapter. The present subsection describes segment types and attributes in more detail. Segments are the cornerstone of the COE approach, and proper determination of their type and associated attributes determines how the COE handles them. Developers have considerable freedom in building segments; however, there are some important considerations regarding them.

- Creation of an account group segment requires prior approval by the Chief Engineer. Most account groups are predefined by the COE itself to establish DII-compliant runtime environments. System designers will typically add an operator account group that establishes the basic runtime environment for their system. Other developers will not normally create account group segments.

- Creation of a COE-component segment requires prior approval by the DII COE Chief Engineer.

- All COTS products shall be packaged as individual COTS segments, unless approved by the DII COE Chief Engineer. This requirement is mandated to make it easier to handle COTS licenses, and to ensure that a single version of a COTS product is in use. Dependencies on COTS product versions must be identified and coordinated with DISA to ensure that the proper version is supported by the COE.

- Segments shall not modify any file that lies outside the segment's directory. Community files may be modified only through public APIs or through requests made to the COE installation tools.

Segment types are identified by the `$TYPE` keyword in the `SegName` descriptor. Segment attributes are also specified in the `$TYPE` keyword by the presence of an optional attribute parameter. See subsection 5.5.33 below for details.

5.4.1 COTS Segment Types

The COTS segment type is used to describe the installation of COTS products. It is preferable to structure a COTS product as a software segment, if at all possible, because it provides more control over the installation and placement of the COTS product. However, this is sometimes not possible because where COTS products will be loaded, what environment extensions are required, etc. are often very vendor-specific.

The COE must retain segment information about all segments, including COTS products. The segment descriptor information for all COTS segments is located underneath the directory `/h/COTS` as shown in Figure 5-5. COTS software is not necessarily actually stored in the directory `/h/COTS`. Frequently only the segment descriptor information is stored there because the actual location of COTS products is often spread across several subdirectories (such as `/usr`, `/usr/lib/X11`, and `/etc`).

Using Unix as the example, Figure 5-5 shows the segment descriptor information for the operating system (`UNIX`), the X Windows environment (`XWindows`), the Motif window manager and libraries (`Motif`), and the Common Desktop Environment software (`CDE`). These four subdirectories, along with the actual COTS software, are loaded with the kernel COE. The example in Figure 5-5 also shows that the DCE COTS product has been installed.

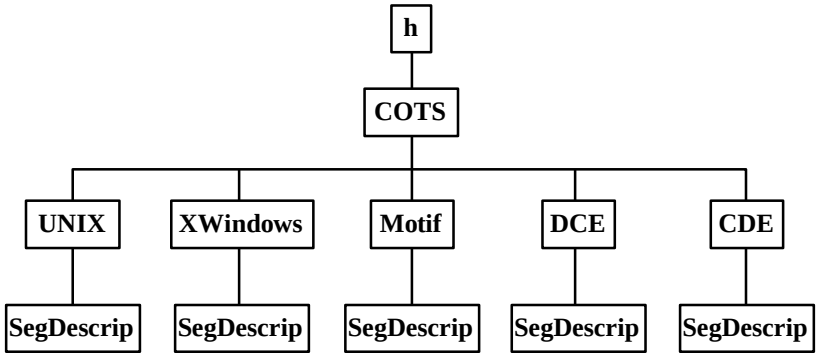


Figure 5-5: COTS Directory Structure

COTS products sometimes have very specific requirements as to the location of files within the product. The general approach to such segments is to create a temporary segment structure in which to store the COTS product, copy the COTS files to their required location during installation, and then copy the segment descriptor information to `/h/COTS`. It is the responsibility of the `PostInstall` script (see below) to copy the COTS files to their appropriate directories and to perform any other required initialization steps. The installation software handles moving the segment descriptor information to the standard location, `/h/COTS`.

For example, assume a COTS product called `SampleCots` is to be installed which requires loading a series of files into `/etc` (files `f1`, `f2`, and `f3`), `/usr/local` (files `f4` and `f5`), and `/usr/lib` (files `f6`, `f7`, `f8`, and `f9`). A segment directory structure can be set up in whatever manner is most convenient. Figure 5-6 shows one possible solution. The installation software will load the segment `SampleCots` wherever there is room on the disk and will set the environment variable `INSTALL_DIR` to the absolute pathname to where `SampleCots` was loaded. The `PostInstall` script for this example must recursively copy the subdirectories `etc` and `usr` from `INSTALL_DIR` to `/etc` and `/usr`. The installation software will copy the segment descriptor information to `/h/COTS/SampleCots` and then delete all files underneath `INSTALL_DIR`.

As an alternative, the COE allows a segment to specify exactly where it must be loaded. This is done with the `$HOME_DIR` directive described in subsection 5.5 below. This reduces the need to copy files from one directory to another, and eliminates the temporary disk space required during installation (e.g., to temporarily store the segment when it is read from tape, then copy it to its new location, then delete the temporary location).

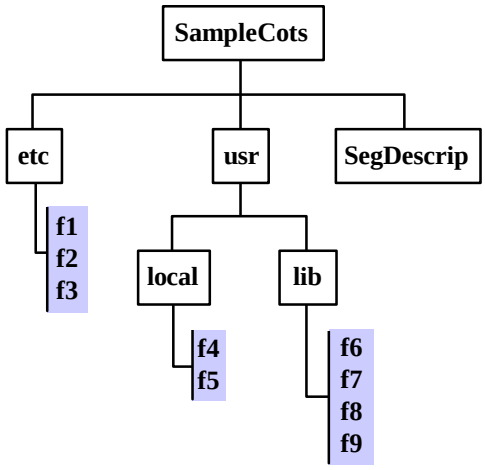


Figure 5-6: Example COTS Segment Structure

The segment descriptor file `FilesList` (see subsection 5.5.14) is used to document where a COTS product was installed. The `FilesList` descriptor for this example is

```
$PATH:/etc
$FILES
f1
f2
f3
$PATH:/usr
$FILES
local/f4
local/f5
lib/f6
lib/f7
lib/f8
lib/f9
```

To summarize the COTS segment type:

- COTS products should be installed as a software segment type if possible.
- The COTS segment's `PostInstall` script is responsible for copying files to their required location. The `PostInstall` script must ensure that enough space exists.
- The installation software places the segment descriptor information underneath `/h/COTS/`*`SegDir`* where *SegDir* is the segment directory name chosen for the temporary segment structure (`SampleCots` in the example above).
- The installation software automatically deletes the temporary segment structure after installation is complete.

- COTS segments shall document what files are loaded and their location in the `FilesList` segment descriptor file.

> **Note:** Developers should normally not include the vendor name in the segment name because this makes the segment vendor-specific. Other segments which then depend upon the COTS product are affected because they then become vendor-specific as well. For example, a segment name such as "DCE" is preferable to "Vendor A DCE" because segments may specify a dependency on a segment whose name is "DCE" rather than "Vendor A DCE." This is especially the case when the COTS product is the implementation of an industry standard. However, it is sometimes advisable to include the vendor name because the product truly is vendor-proprietary. This is typically the case with an RDBMS.

5.4.2 Account Group Segment Types

An account group segment is a template for establishing a basic runtime environment context that other segments may extend in a controlled fashion. An account group segment determines

- the processes to launch,
- the order in which to launch processes, and
- the required environment script files (`.cshrc`, `.login`, etc.).

Account groups may also contain executables and data in the subdirectories identified in Figure 5-2.

The COE provides several predefined account groups. They are located underneath `/h/AcctGrps` shown in Figure 5-1. Important predefined account groups include the following:

`CharIF`	account group for character-based interfaces
`DBAdm`	account group for database administrators
`SecAdm`	account group for security administrators
`SysAdm`	account group for system administrators

In addition to these account groups, COE-based system designers will generally create their own account group for normal operator accounts (`GCCS` for the Global Command and Control System, `GCSS` for the Global Command Support System, `ECPN` for the Electronic Commerce Processing Node system, etc.). They will include `CharIF` if the

system supports a character-based interface and may include other account groups to suit system mission requirements.

Figure 5-7 shows how the Unix System Administrator account group is structured. It demonstrates what account groups are for and how they are used in building a COE-based system.

`bin` Subdirectory

Account groups utilize COE executables, located underneath `/h/COE/bin`, but will usually include additional account group specific programs. These are located in the account group's `bin` subdirectory. DII compliance requires that executables within this subdirectory use the segment prefix to avoid potential naming conflicts with other executables.

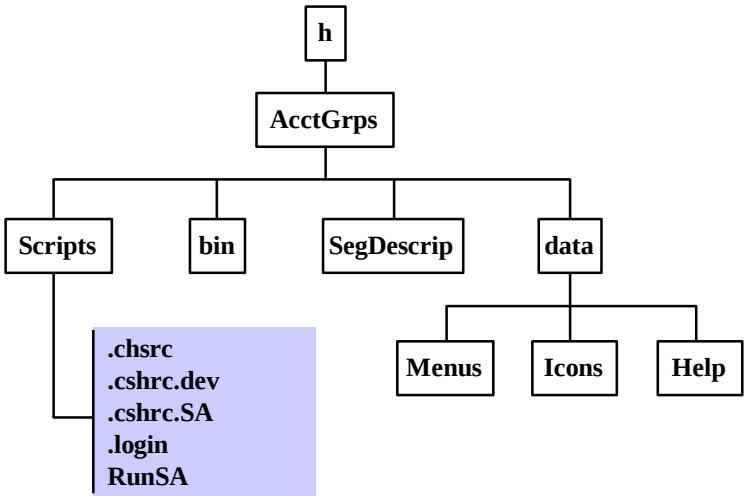


Figure 5-7: Example Account Group Directory Structure

`data` Subdirectory

Segment data specific to the System Administrator account group is located in the `data` subdirectory. The `Menus` subdirectory contains menu files that have menu entries for all options available from the basic System Administrator application. The segment installation software may modify files contained here to add other menu options. Account group menu files are used as templates from which profiles are created by including or excluding desired menu items and execution permissions. The `Icons` subdirectory is analogous, but defines icons for use by the desktop for launching applications.

Help files are located underneath the `data/Help` subdirectory and identified through the `Help` segment descriptor. Refer to subsection 5.5.16 below for more details on this segment descriptor.

`Scripts` Subdirectory

A Unix account group segment will usually contain at least the following two scripts to establish the runtime environment:

`.cshrc`	define environment variables
`.login`	define terminal characteristics

Precise contents of these files is application-dependent. Other segments may be loaded to extend the environment established by the account group. This is done through *environment extension files*. DII-compliant account group segments shall name environment extension files in the form

`scriptname.segprefix`

where *scriptname* is the environment file to be extended and *segprefix* is the segment prefix. For the example shown in Figure 5-7, the environment extension files are:

`.cshrc.SA`	extensions to the `.cshrc` file
`.login.SA`	extensions to the `.login` file

Extension of the `.login` file is seldom required.

Environment extension files permit COE installation software to provide segment-specific environment modifications. A segment uses the descriptor file `ReqrdScripts` (see below) to indicate which environment file to extend and the installation tools modify the proper file within the account group segment.

For example, suppose the installation tools have loaded a segment underneath `/h/SAOpt` and the `SAOpt` segment has an environment extension file named `.cshrc.SAOpt` in the segment's `Scripts` subdirectory. The installation tools will include the new environment settings by inserting the following statements in the account group's file `.cshrc.SA`:

```
if (-e /h/SAOpt/Scripts/.cshrc.SAOpt) then
     source /h/SAOpt/Scripts/.cshrc.SAOpt
endif
```

The installation tools automatically remove these statements from `.cshrc.SA` if the segment `SAOpt` is deleted.

Account group segment developer's shall ensure that environment extension files are included and accounted for in the appropriate account group segment's scripts. For example, the `.cshrc` file shown in Figure 5-7 includes the following statements

```
if (-e $SA_HOME/Scripts/.cshrc.SA) then
     source $SA_HOME/Scripts/.cshrc.SA
endif
```

to account for `.cshrc` extensions. Also note that the `source` command shall be of the form

```
source $SA_HOME/Scripts/.cshrc.SA
```

rather than

```
source $USER_HOME/Scripts/.cshrc.SA
```

The COE-mandated form ensures a single copy of the environment extension file, updated and maintained by the installation software.

The file `.cshrc.dev` shown in Figure 5-7 relates to the software development environment. It is not a required file, but is described here as an example of how the development environment can be accommodated, yet kept separate from the runtime environment. In the example shown, developer preferences such as alias commands are included in `.cshrc.dev`. These preferences *must* not be included as part of the runtime environment. A technique such as

```
if ($?DEVELOPER) then
     source $SA_HOME/Scripts/.cshrc.dev
endif
```

within the `.cshrc` file is required to achieve separation of the development environment from the runtime environment. This technique will not work for certain files, such as `.mwmrc`, because they do not support conditional statements.

Account groups must include the base environment established by the COE. Subsection 5.4.8 below describes the COE-component segments in more detail. The `.cshrc` file in Figure 5-7 includes the base COE environment with the statements

```
if (-e /h/COE/Scripts/.cshrc.COE) then
     source /h/COE/Scripts/.cshrc.COE
endif
```

The remaining files in Figure 5-7 contain similar statements to include other COE environmental settings.

Account groups must also provide a script or program which launches the application. This is the file named `RunSA` shown in Figure 5-7. DII compliance requires this file to be located underneath the `Scripts` subdirectory.[14]

To summarize compliance requirements for account groups:

[14] This program is required for backwards compatibility and as an aid to integrators and testers. It may be phased out in a future release because the program is not necessarily used in the operational system, depending upon the characteristics of the system desktop.

- Account group segments shall provide environment extension files of the form *`scriptpname.segprefix`*, where *scriptname* is the name of the script which sets the environment, and *segprefix* is the account group's segment prefix. This must be done for any files that other segments may extend (e.g., `.cshrc.SA` for the `SysAdm` account group).

- Account group executables shall use the segment prefix to avoid naming conflicts.

- Account group segments shall not include the developer environment as part of the runtime environment.

- Account group segments shall provide a single program or script with the name `Run`*`segprefix`*, where *segprefix* is the segment prefix, to initiate execution of the account group's application. This executable shall be located in the account group segment's `Scripts` subdirectory.

- Account group segments shall automatically include environment settings established in `/h/COE/Scripts`.

- Segment developers shall not modify account group files except through use of the installation software.

- Segment developers shall not override environmental settings established by the account group. Segments may use environment extension files to expand the environmental settings.

5.4.3 Software Segment Types

Software segments add functionality to one or more account groups. The account group(s) to which the software segment applies is called the *affected account group(s)*. The directory structure for a software segment was presented in Figure 5-2.

Software segments frequently need to extend the runtime environment, add new menus and icons to the desktop, and include new executables in the search path. Environment extension files are located underneath the software segment's `Scripts` subdirectory. The `ReqrdScripts` segment descriptor file (see below) indicates which environment files are to be extended.

Software segments provide additional menu and icon files underneath the segment's `data/Menus` and `data/Icons` subdirectories respectively. The segment descriptor files `Menus` and `Icons` (see below) are used to describe where the new items are to appear on the desktop. At installation time, the menu and icon files from all contributing segments are added to the affected account group. This then serves as a master template

of all possible functions provided within the account group. Profiles are then created by selectively including or excluding functions within this master template.

Unix segments that provide executables must ensure that the `bin` subdirectory is included in the search path. This is accomplished by including a statement of the following form in a `.cshrc` extension file:

```
set path =($path $segprefix_HOME/bin)
```

The segment shall append its `bin` subdirectory, and *only* its `bin` subdirectory, at the *end* of the search path, *not* the beginning. An implied aspect of this requirement is that segments cannot depend upon a specific loading sequence, other than that a segment will not be loaded until after all segments it depends upon are loaded. A specific requirement is that segments shall *not* insert the current working directory (i.e., ".") into the search path.

DII compliance requires the following:

- Segments shall not make separate copies of executables from other segments, the operating system, or other COTS products.
- Segments shall use environment extension files as necessary to extend the environment established by the affected account group.
- Segments shall use the segment prefix to name objects whenever conflicts may arise with other segments.
- Segments shall be completely self-contained. Dependencies on, or conflicts with, other segments shall be specified through the appropriate `Requires` or `Conflicts` segment descriptor files.
- Segments shall not insert the current working directory into the search path for executables.
- (Unix) Segments shall include their `bin` subdirectory at the end of the search path, not at the beginning nor in the middle.

5.4.4 Data Segment Types

Data files are most often created explicitly at runtime by a segment or loaded as part of the segment itself. However, the ability to load data as a separate segment is useful when there is classified data, optional data, large amounts of data, or data that may not be releasable to all communities. The COE supports five categories of data grouped according to data scope, how the data is accessed, and where the data is located:

Global Data in this category means that every workstation, every application, and every operator on the LAN accesses and uses exactly the same data. Global data is made available through NFS mount points or some similar technique. Examples of global data include the track database and message logs. Global data is located in subdirectories underneath `/h/data/global`.

Database This category is similar to global data but is used to provide data fill for a database segment. Examples of this kind of data include intelligence databases, JOPES data, and TPFDD data. Data is loaded into the appropriate objects previously created by a database segment in a database server. Database segments are discussed further in subsection 5.4.5 below. Data segments for databases are usually removed after successfully loading data into the database server.

Local Local data is limited in scope to an individual workstation. All workstation users and applications access the same data, but the data may (and frequently will) differ from one workstation to another. Examples include overlays and briefing slides, although the COE provides techniques for exporting these to other workstations. Local data is located in subdirectories underneath `/h/data/local`.

Segment Segment data is local to a workstation, but is managed and accessed by a single software segment. This data is located under the segment's `data` subdirectory (e.g., *`SegDir`*`/data` where *SegDir* is the assigned directory) and is typically static data used for segment initialization.

Operator Data in this category is specific to an operator and is the most limited in scope. Typical examples include preferences for map colors, location of various windows, and font size. Operator data is stored in a `data` subdirectory underneath `/h/USERS` created for the operator when the operator login account is created, as described in subsection 5.2.2.

There are some important considerations with respect to these data categories:

- Data is not necessarily available to an operator or process even if the data scope would otherwise permit it. Discretionary access controls limit access based upon the security policy of the system.

- In some cases, data that could be global is replicated on every workstation to improve system performance. For example, World Vector Shoreline data is identical for everyone on the LAN, and hence meets the criteria for the global data category. However, for efficiency, this data may be replicated on each workstation which requires maps and is thus considered local.

- Distinction is made between segment data and local data because it affects where the data is stored on the disk. Local data for all segments is stored in a single place to make it easier for doing data backups. Because segment data is normally static, it does not usually need to be archived and remains with the segment.

Segment data created at runtime or loaded as part of the segment does not require any special consideration by the COE. The remainder of this subsection will deal with the COE requirements for local and global data, and then present an example of how a data segment is structured for local, global, and segment scope.

`global` and `local` Subdirectories

Figure 5-8 shows the directory structure for global and local data. The COE runtime environment sets the environment variable `DATA_DIR` to point to `/h/data`. Segments shall use this environment variable to reference global or local data. The segment which owns the local or global data is responsible for creating and managing its data subdirectories underneath `$DATA_DIR/local` and `$DATA_DIR/global`. Assuming the segment's assigned directory is *SegDir*, the segment shall create a subdirectory of the form *`SegDir`*`/data` under `$DATA_DIR/local` and/or `$DATA_DIR/global` as appropriate.

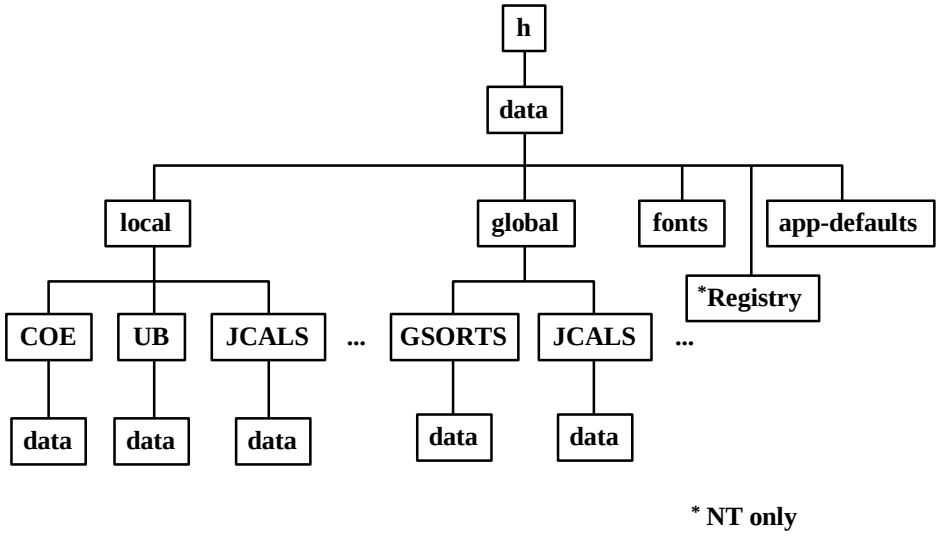


Figure 5-8: Data Directory Structure

For example, suppose a segment that does ASW planning is located underneath `/h/ASW` and it will create both global and local data. Then the ASW segment must create the subdirectory `$DATA_DIR/local/ASW/data` for local data and the subdirectory `$DATA_DIR/global/ASW/data` for global data.

The COE mandates that local and global data be structured in this fashion for the following reasons:

- Centralizing data makes it easier to archive and restore. A simple data archive/restore utility can be created without needing to know how many segments are loaded in the system.

- Separating data from software makes it simple to load the software without destructively overwriting existing data. This is especially important as segments are upgraded.

- Collecting all global data under a single directory reduces the number of NFS-type mount points and improves overall network performance.

- Organizing data into a standard structure simplifies training and simplifies determination of what data is loaded in the system.

`fonts` and `app-defaults` Subdirectories (Unix)

Figure 5-8 shows two additional subdirectories, `fonts` and `app-defaults`. These are applicable to Unix only. The COE sets environment variables `XFONTSDIR` and `XAPPLRESDIR` to point to these subdirectories. Their purpose is to contain additional fonts (such as NTDS symbology) or application resource files that are not provided by the standard X/Motif distribution. It is a violation of the COE for a segment to overwrite or add files to the standard X/Motif distribution.

During installation, the installation tools look for subdirectories `data/fonts` and `data/app-defaults` underneath the segment's directory. Files contained within these subdirectories must use the segment prefix to guarantee unique names. The installation tools creates a symbolic link underneath the directory `$DATA_DIR/fonts` to every file in the segment's `data/fonts` subdirectory and removes the links when the segment is deinstalled. Similarly, links are created for files underneath the segment's `data/app-defaults` subdirectory.

Creating a data segment requires additional considerations. A segment structure is created for the data and the installation tools *logically* insert the data underneath `$DATA_DIR` for global and local scope, but underneath the parent segment for segment data. This is best described through use of an example.

Assume a mine countermeasures decision aid has an assigned directory of `MineTDA`. Assume that a separate data segment is to contain parametric data on floating, proximity, and land mines for the decision aid. Figure 5-9 shows the appropriate directory structure for the data segment. Further assume that when installed, the decision aid is located underneath `/h/MineTDA`. Consider how the installation tools handle the mine data segment for global, local, and segment scope.

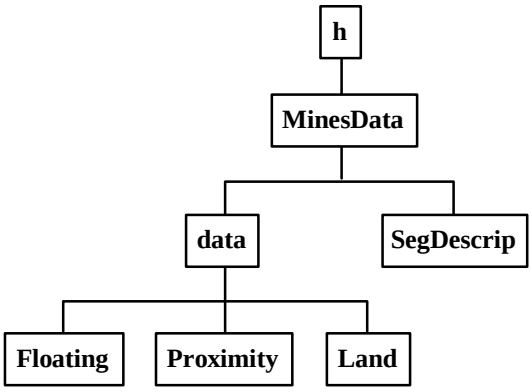


Figure 5-9: Example Data Segment Structure

Global Scope Example

The `Data` descriptor file (see below) describes the data scope. For a global data segment, the installation tools will load the mine data underneath the directory `$DATA_DIR/global/MinesData`. If there is insufficient space to load the segment underneath `$DATA_DIR/global`, the install tools will report an error and abort. The mine TDA can thus reference global proximity-mine data as being underneath the directory `$DATA_DIR/global/MinesData/data/Proximity`.

Local Scope Example

For a local data segment, the installation tools will load the mine data on the first available disk partition. The installation tools will then create a symbolic link from `$DATA_DIR/local/MinesData/data` to wherever the data segment was actually loaded. That is, if the data segment is loaded underneath `/home2/MineData`, then the symbolic link will point to the directory `/home2/MineData/data`. The mine TDA can still reference local proximity mine data as being underneath the directory `$DATA_DIR/local/MinesData/data/Proximity`.

Segment Scope Example

For segment scope data, the installation tools will load the mine data on the first available disk partition. A symbolic link is then created from the directory `/h/MineTDA/data/MinesData/data` to wherever the data segment was actually loaded. Proximity data can thus be referenced as being underneath the directory `$HOME_DIR/data/MinesData/data/Proximity`.

It should now be clear why the COE requires that segments which dynamically create global or local data do so underneath a directory of the form *`SegDir`*`/data`, where *SegDir* is the name of the segment's assigned directory. This creates a uniform technique for locating files whether they are created directly by a segment or loaded as part of a data segment.

In summary, DII compliance mandates that:

- Segments shall create a data subdirectory underneath `$DATA_DIR` for global and local data if they own global or local data. The subdirectory created shall be *`SegDir`*`/data` where *SegDir* is the name of the segment's assigned directory.

- The parent COE-component segment shall set the environment variable `DATA_DIR` to point to `/h/data`.

- Segments shall use the environment variable `DATA_DIR` to reference data underneath `/h/data`.

- Segments are responsible for creating the segment's data subdirectories underneath `/h/data`.

- Segments are responsible for handling the case in which a data file is not present or is corrupted.

- (Unix) The parent COE-component segment will set environment variables `XFONTSDIR` and `XAPPLRESDIR` to point to `$DATA_DIR/fonts` and `$DATA_DIR/app-defaults` respectively.

- (Unix) Segments shall place fonts that need to be accessible via `XFONTSDIR` in the segment's *`SegDir`*`/data/fonts` subdirectory. Files in this subdirectory shall be named using the segment prefix.

- (Unix) Segments shall place application resource files that need to be accessible via `XAPPLRESDIR` in the segment's `data/app-defaults` subdirectory. Files in this subdirectory shall be named using the segment prefix.

5.4.5 Database Segment Types

The database segment type is similar in concept to the data segment type, except that the data within a database segment type is managed by a DBMS. Data within a data segment type is typically organized as a "flat file" and is typically managed by the operating system's file system.

As explained in Chapter 2, a database segment has scope, which is and indication of how widely the data is shared, not of where the data is located, as is the case with the data segment type already described. This scope is indicated in the Database segment descriptor discussed in subsection 5.5.9. Data within a database segment type may be:

Unique This type of database segment indicates that the data is used by only one application, or is under the configuration control of the segment sponsor. Unique data represents no sharing between segments.

Shared This type of database segment indicates that the associated data is used by multiple mission-application segments or is managed across multiple database segments. Data is shared, but typically only within one mission domain (e.g., logistics, financial, command and control).

Universal Data in this category represents the most extreme form of "shareability." These database segments represent widespread usage across mission domains, application segments, and require centralized configuration management.

A database segment contains everything that is to be installed on the database server under the management of the DBMS and the ownership of the DBA. It contains the scripts to create a component database and any utilities provided by the developers for the DBA's use in installing and filling that particular database. These scripts must include those for granting and revoking database roles. The only applications permitted in a database segment are those that support its installation and data fill or that extend DBMS services for the DBA. Database segments may only be installed on a database server.

When a database segment is installed it must first lay down any scripts, data files, etc. that will be used to create the database. These scripts are then executed by `PostInstall` to create the component database. They must first allocate storage to hold the database and create one or more database accounts to own that database. They then can create the database within the storage just allocated and fill it with data. Finally, roles are created to manage access and the roles are given the appropriate privileges.

Developers cannot provide data files for the DBMS as part of the segment. Database files must be created using the DBMS vendor's utilities (e.g. Oracle's SQL*DBA `CREATE TABLESPACE` command) to be correctly incorporated in the DBMS instance.

Figure 5-10 is the same as Figure 5-2 except that it has been shaded to highlight the directories which are used only for database segments, and directories which are not required at runtime have been removed. *Seg* is the segment's assigned directory. It is unique and, for a database segment, it must be the same as the name of the database owner account for the segment's data objects.

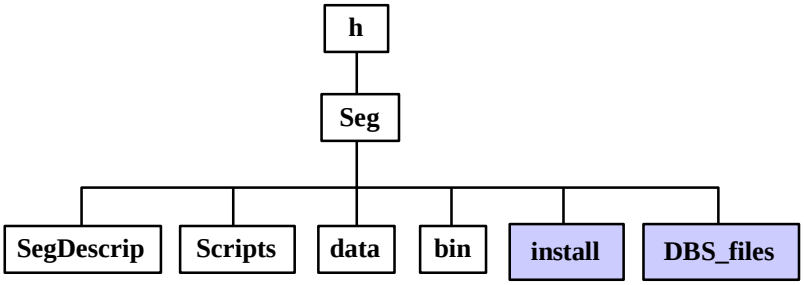


Figure 5-10: Database Segment Structure

`Scripts` Subdirectory

The `Scripts` subdirectory shall contain any segment-specific scripts needed to set the environment for the database installation. This includes environment variables for all directory paths that are used by the installation scripts. Note that this directory is used as a place to store installation-related environmental scripts. As with the development environment, scripts and environmental settings which are used only for installation must be kept separate from those used by the runtime environment.

`SegDescrip` Subdirectory

The `SegDescrip` subdirectory contains the descriptor files necessary to install the database segment. Certain information specific to database segments must be incorporated in the `SegInfo` file. The `Database` descriptor is used to identify information such as object dependencies that are within the database and therefore cannot be evaluated without the use of the DBMS. See subsection 5.5.9 for the associated keywords for this segment descriptor.

The `PreInstall` descriptor file should prompt the installer to provide the password for the DBMS' database administrator account. The password prompt must be implemented via the `COEPromptPasswd` API (see Appendix C) provided by the COE Services. The DBA password entered is used later by the scripts that perform the installation of the database segment.

The `PostInstall` descriptor file is used to set up the installation environment, start the RDBMS if necessary, and invoke the scripts that perform the installation of the database segment.

For database segments, the `ReleaseNotes` descriptor should show how applications, operating system groups, and database roles are associated. Developers should also provide the database schema, including its dependencies. In addition to any narrative information in this file, developers should include comments on their schema, data objects, and data elements as part of their database build.

The `Requires` descriptor must identify the required RDBMS and version. It must also identify all dependencies on other database segments.

As with data segments, database segments have a scope associated with them. The scope is specified in the `Database` segment descriptor, as explained below in subsection 5.5.9.

`install` Subdirectory

The `install` subdirectory contains the scripts to install and then create the database segment. It includes all of the database definition language (DDL) scripts that create the database objects for the segment. There are two sets of DDL scripts in this directory. The first set allocates storage for the database, creates the database owner, and defines the roles associated with the database segment. It must be executed by a DBA. The second set creates all database objects (tables, views, indexes, sequences, constraints, triggers, etc.) that make up the database. This set must be executed by the database owner.

The naming conventions to be used for database definition scripts and the structure of those scripts are discussed in Chapter 4.

`data` Subdirectory

The `data` subdirectory contains any data files used to load the database. Data fill may also be provided in a separate data segment if developers wish or need to keep the fill separate.

Several methods for loading data, depending on data size, are discussed in subsection 5.8.3.

`bin` Subdirectory

The `bin` subdirectory contains any scripts or other executables used to load data from the data files into the database. It may also contain any applications that support unique database administration requirements for that database segment.

`DBS_files` Subdirectory

The `DBS_files` subdirectory contains the DBMS-controlled data files that make up the storage for the database. This directory is owned by the DBMS, not the segment. The data files are created during the installation of the segment, normally in the `PostInstall` process. Directory ownership must be transferred to the DBMS before the data files are created. Note that this does not allow developers to stipulate disk architecture.

5.4.6 Patch Segment Types

The COE supports the ability to install field patches on an installed software base. A patch segment permits the replacement of one or more individual files, including those of the

operating system. It does *not* refer to overwriting a portion of a file, as is sometimes done to patch a section of binary code.

Patches are created in a segment whose directory name is the directory name of the affected segment followed by a ".", followed by the letter "P", followed by the patch number. Figure 5-11 shows an example patch segment directory structure for applying patch 5 to an ASW segment. The subdirectory `SegDescrip` is required, but the remaining subdirectories are patch-dependent. The example illustrates a situation in which scripts, executables, and data files are to be updated by installation of a single patch segment.

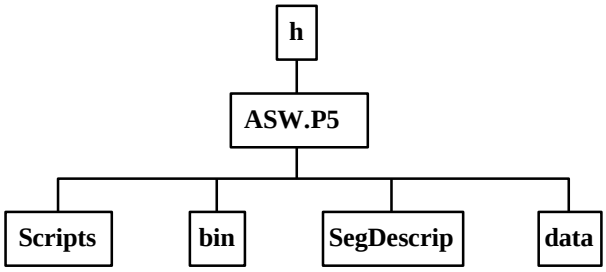


Figure 5-11: Example Patch Directory Structure

The installation software loads patches underneath the affected segment in a subdirectory called `Patches`. Figure 5-12 shows the result of loading patch 5 from Figure 5-11. This approach makes it easy to find and identify what patches have been applied to a segment. It also makes it easy for the installation software to automatically remove patches when a segment is replaced by a later update. If there is insufficient room to physically load the patch underneath the `Patches` subdirectory, the patch is loaded on the first available disk partition. A symbolic link is then created to preserve the logical structure shown. Also note that when installed, the resulting subdirectory name of the patch for this example is `P5`, not `ASW.P5`.

As patches are installed and removed, the descriptor file `Installed` in the segment descriptor directory for the affected segment is updated to reflect what patches are installed and removed, the date and time, the installer's name, and the workstation from which the work was done.

When a patch is installed, it is the patch segment's responsibility to perform whatever operations are necessary to replace files. In the example shown, the `PostInstall` script must copy files from `Scripts`, `bin`, and `data` as required to update files in the existing ASW segment.

To facilitate patch removal, the `PostInstall` program may create compressed copies of files before they are modified and put them underneath the patch subdirectory (e.g., the `ASW/Patches/P5` subdirectory in this example). In this way, a `DEINSTALL` descriptor simply needs to copy the files from the patch subdirectory to their original place and

decompress them to restore the system to the pre-patch state. If the files being replaced are large, this may require too much disk space to store the original files. In such cases, the patch segment should be designated as a permanent patch and not make copies. A patch segment is considered to be permanent if the patch segment does not include a `DEINSTALL` descriptor.

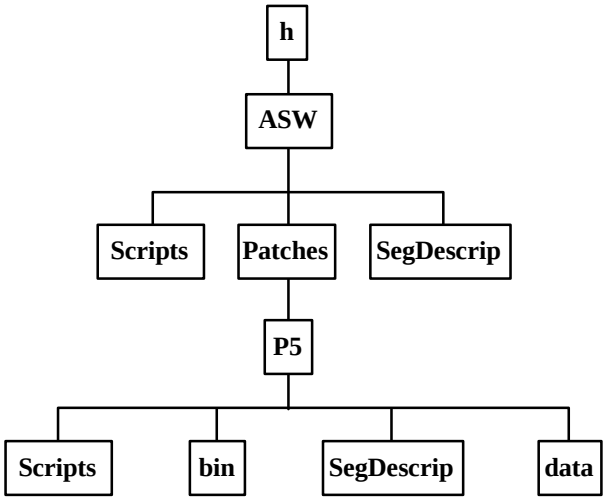


Figure 5-12: Example Installed Patch

The COE installation software assumes that higher numbered patches must be removed before a lower numbered patch can be removed. For example, patch 2 cannot be removed until patch 5 is removed. However, if patch 5 cannot be removed - because there is no `DEINSTALL` descriptor for patch 5 - patches 1 and 2 cannot be removed either. The only way to remove them is to remove the entire segment.

DII compliance requires that:

- Patch segments shall be named *`SegDir`*`.P`*`number`* where *SegDir* is the assigned directory name for the segment to be patched, and *number* is a sequential patch number.

- Patch segments shall perform the necessary operations to replace files through the `PostInstall` script.

- Permanent patch segments shall be designated by the absence of a `DEINSTALL` script.

Patch segments can also be used to make updates to a database segment prior to the release of a new database segment that incorporates the patch. The patch segment structure will be the same as the database segment being patched, and the patch name follows the same conventions as for any other patch segment.

Any objects, scripts, etc. that are being updated will be in the same location under the patch segment directory as the corresponding original is under the database segment directory. `PostInstall` will be used to backup the original and copy the new file to the database segment directory. The patch segment will have the same owner as the database segment being patched.

Any changes to executables provided with the patch will be implemented in the same manner as patches to other software segments. Any changes to the database provided with the segment will require an analysis to determine application segment dependencies. Changes to the database must be coordinated with application segment developers.

If the patch segment is making any changes to the database objects, its developers are responsible for preserving the information those objects currently contain, together with restoring any permissions that have been granted on the objects. This usually requires extracting and saving the records from the objects being modified, making the schema changes, and then reloading their data. That portion of the patch segment must be implemented in a manner that allows it to be restarted or re-executed without data loss in the event of system or media failure during the patch installation.

5.4.7 Aggregate, Parent, and Child Attributes

It is sometimes convenient for a collection of segments to be treated as an indivisible unit. The aggregate attribute provides this capability and the collection of segments are called an aggregate segment. One, and only one, segment is designated as the *parent* segment and the remaining segments are designated as *children*. Parent and child segments are designated as members of an aggregate in the `SegName` descriptor file. The child segment must list its parent segment, while the parent segment must list each child in the aggregate. See subsection 5.5 below for the segment descriptor information required to do this. Each segment within the aggregate is packaged according to its segment type as described in preceding subsections.

The parent segment plays a special role in the aggregate. During installation with the segment installer, only the parent segment is "seen" by the operator. Child components are not displayed as selectable items, but are automatically loaded with the parent. Therefore, the segment name and release notes associated with the parent segment should be carefully chosen to be properly descriptive of the aggregate.

The parent segment is the first segment loaded from the aggregate. Child segments are loaded next in the order listed by the parent segment. Because of this, child segments may specify a dependency on the parent, but shall not specify dependencies upon one another.

In some situations, a child segment in an aggregate should be loaded conditionally. That is, the child should only be loaded if it is not already on disk, or only if it is a later version. An example of this situation is if a collection of segments created by a single developer must use the same executable. One approach would be to create the common executable and put it into its own separate segment. Then all the remaining segments would need to state a dependency upon it. An alternative approach, supported here, is to package the common

executable as a child segment that is to be conditionally loaded and placed in an aggregate with each segment that needs it. The conditional load capability is specified by the `$LOADCOND` keyword in the child segment's `SegName` descriptor (see subsection 5.5.33 below).

The COE requires that each segment include a `Security` segment descriptor file. This file is used primarily as a documentation aid and is used by the installer tool to indicate which segments are classified at what level. The security level of the parent segment must dominate that of the child segments. For example, if a child segment has a SECRET classification, then the parent segment must have a SECRET or higher classification. The segment developer must ensure that each segment in the aggregate is compatible for the hardware platform. `VerifySeg` will check for this condition and reject an aggregate with incompatible hardware platforms specified.

Disk space required is specified by each individual segment, not by the aggregate parent. The COE installation tools may load parent and child segments on different disk partitions, depending upon space available at install time. During installation, the space reported to the installer takes into account whether or not the aggregate includes a conditional load child, and whether or not the segment is already on disk. That is, the installer tool reports the *additional* space required on the disk to load the selected segment(s).

DII compliance requires:

- One and only segment in the aggregate shall be designated as the parent segment.
- Child segments may specify a dependency on the parent, but shall not specify dependencies upon one another.
- The security level of the parent segment shall dominate the security level of all child segments.
- Segments within an aggregate shall be consistent with regard to the hardware platform specified.
- Segments shall individually specify their own disk space requirements.

5.4.8 COE-Component Attribute

Authorized segments may specify the attribute of being a COE-component segment. COE-component segments are similar to aggregate segments in that one segment serves the role of a parent segment and all others are children to that parent. The parent segment is similar to an account group segment which is affected by a collection of child component segments. However, there are important differences between COE-component segments and aggregate segments, and between the parent COE-component segment and account groups.

- At installation time, a segment identified as a COE component must have an authorization key[15] (see the $KEY keyword below) specified or else the segment will be rejected.

- Exactly one segment is designated as the parent COE component for the entire system. This is the segment whose directory is /h/COE.

- Child COE-component segments are not loaded unless they are required. That is, a child COE-component segment will not be loaded unless there is another segment which expresses a dependency upon it.

- COE-component segments are organized into a very specific structure.

- The parent COE-component segment does not set up a runtime environment. It sets up a baseline environment which is inherited by all account groups.

Figure 5-13 shows the directory structure for COE-component segments. Since COE components form the foundation for the entire system, they are collected together in a single place and are validated more rigorously during segment development, integration, and installation. Special processing, as explained below, is performed on the COE components because of their unique position within the architecture.

The SegDescrip subdirectory, required for all segments, underneath /h/COE refers to the collection of COE components as a whole. Segments designated as child COE components are loaded in the subdirectory /h/COE/Comp. Each child COE-component segment has its own SegDescrip, bin, Scripts, and data subdirectory as appropriate. If insufficient space exists to load the COE component directly under /h/COE/Comp, a symbolic link is created to where the segment was actually loaded.

Environment files underneath /h/COE/Scripts are included by every account group so that they are automatically inherited by every segment. The file .cshrc.COE sets the path environment variable so that /h/COE/bin is first in the search path before any other segments. Environment extensions for child COE components are handled differently than environment extensions for other segments. As child COE-component segments are installed, environment extension files located underneath the child COE component's Scripts subdirectory are textually inserted directly into the appropriate file underneath /h/COE/Scripts. This insertion is performed automatically by the installation tools. This is done to avoid the runtime overhead of executing several source statements to pick up child segment extensions.

[15] To preserve backwards compatibility, segments which are already authorized as COE-component segments are not required to use the $KEY keyword for this *I&RTS* release. However, they are required to migrate to this approach. In the interim, a legacy segment identified as a COE-component segment which does not use the $KEY keyword is compared against a table containing the names of authorized COE-component segments. If it does not match, the segment is rejected. All new COE-component segments must use the $KEY keyword.

Child COE-component segments shall not alter the `path` environment variable. It is not necessary to do so because as child COE components are loaded, the installation tools create a symbolic link underneath `/h/COE/bin` to where the executables were actually loaded. This is done so that the search path contains only one entry for the COE, regardless of the number of actual segments comprising the installed COE. This approach mandates that all COE-component segments use the segment prefix to name executables. `VerifySeg` will issue a warning for COE-component segments that do not meet this requirement, but in a future release it will strictly fail such a component.

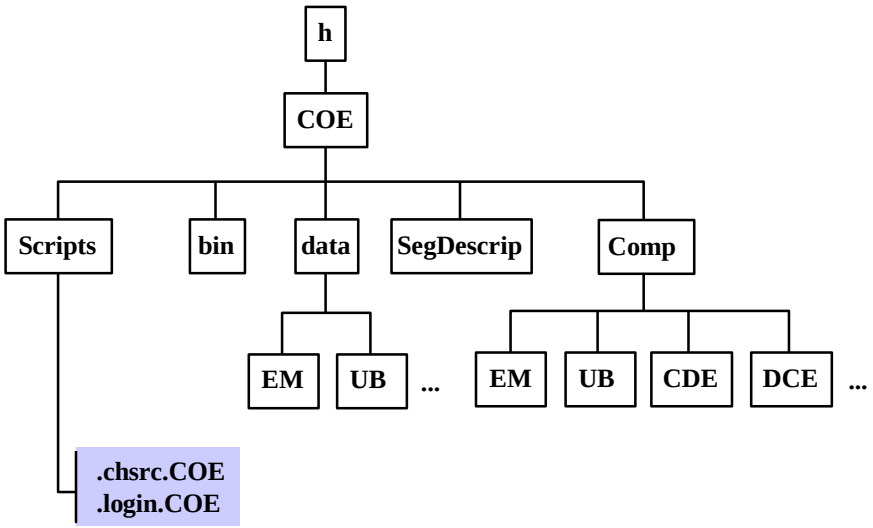


Figure 5-13: COE-Component Segments Directory Structure

Symbolic links are also created underneath `/h/COE/data` to point to the child COE component's `data` subdirectory. The installation tools automatically delete these symbolic links when a COE-component segment is deinstalled.

To summarize DII compliance requirements:

- COE components shall be authorized by the DII COE Chief Engineer. They will be issued an authorization key that the developer shall specify in the segment with the `$KEY` keyword.

- Child COE components shall not alter the `path` environment variable.

- COE components shall use the segment prefix to name all executables.

- Child COE components shall use the segment prefix to name all public symbols contained in files within the segment's `Scripts` subdirectory.

5.4.9 Web Attribute

Segment types that have the Web attribute are either Web servers or Web-application segments (e.g., Web clients). By definition, Web servers are also COE-component segments, so they have that implied attribute as well. Web applications may or may not be COE components, and so must indicate explicitly whether or not they are. This is described in subsection 5.5.33 below.

Web applications can only be installed on a platform that already has a Web server loaded on it. Therefore Web applications must be designed so that they can access other COE services that may be located on another platform, possibly even behind a firewall. This allows sites to isolate the main COE-based system from the Web server by firewalls or other security-related techniques.

Other than specifying the Web attribute, no additional segment descriptors are presently required beyond those identified for all other segments.

5.4.10 Generic Attribute

The Generic attribute is provided to allow a segment to indicate that it should be automatically made a member of all "regular" account groups. This means that the segment, unless it indicates otherwise, will be made a participant of all account groups except those which are character-interface-based (e.g., `CharIF`) or accessed through remote execution account groups such as `RemoteX`.

This capability is provided for two reasons. First, some segments should be made a member of virtually every account group. An example is a Web browser which is set up to provide access to HTML help pages. Such a segment should be a member of the following:

- the System Admin account group
- the Security Admin account group
- the Database Admin account group
- the operator account group (e.g., GCCS, ECPN).

It is convenient that this happen automatically without the need for the segment to explicitly list every account group it is to be a member of. Such segments do not need to express any affected account group in the `SegName` descriptor.

Second, some segments developed for one system may be generally applicable to other mission systems, yet this may not have been realized when the segment was created. Using the Web browser example, if it is packaged for GCCS and it states `GCCS` is the affected account group, the segment's `SegName` descriptor will need to be modified to use it for a different system such as ECPN or GCSS. Declaring the segment to have the generic attribute avoids this problem.

There are some special points to note about segments which declare the generic attribute:

- The segment is automatically added to *every* account group except `CharIF` and `RemoteX`.

- Site administrators can establish user profiles to deny an operator access to the generic segment, even if it is a member of an account group.

- The generic segment is only stored on the disk once, regardless of how many account groups it is made a member of.

- Generic segments may exclude account groups by listing the groups to exclude with the `$EXCLUDE` keyword in the `SegName` descriptor.

- The generic attribute may be combined with other segment attributes. Subsection 5.5.33 states which attributes may be combined.

5.4.11 Segment Dependencies

Segments specify dependencies upon one another through the `Requires` descriptor, and, for database segments with database dependencies, the `Database` descriptor described below. However, the COE does not allow circular dependencies. That is, a situation where Seg A depends upon Seg B, Seg B depends upon Seg C, and Seg C depends upon Seg A is strictly forbidden.

Components of an aggregate may have dependencies upon other components within the same aggregate and such dependencies could lead to the circular situation just described. But since components of an aggregate are always loaded together as a unit, this does not pose a problem. Child components of an aggregate must *not* specify dependencies upon one another in the `Requires` file, even if they do indeed have such dependencies. Likewise, the parent segment must *not* specify a dependency on children within the aggregate. An aggregate of database segments cannot have circular database dependencies among the segments or there will be no valid database creation order.

5.5 Segment Descriptors

This section details the contents of the segment descriptor files. These files are the key to providing seamless and coordinated systems integration across all segments. Adherence to the format described here is required for all segments to ensure DII compliance. This enables automatic verification and installation of segments.

The software tool `VerifySeg` must be run during the development phase to ensure that segments properly use segment descriptor files. The software tool `MakeInstall` uses information in segment descriptor files to compress and package segments in a format suitable for installation from tape, from a disk-based LAN segment server, from a remote site, or from other media. At installation time, the installation tools use segment descriptor information to make the COE changes required (e.g., update menu files) so that software components are available to the user.

Some segment information is contained within individual files while other segment information is collected into a single file, `SegInfo`. `SegInfo` is an ASCII file (similar to a Windows `.INI` file) with multiple sections containing segment descriptor information. Table 5-4 lists each of the descriptor files and which are required, optional, or not applicable for each segment type. Table 5-5 lists the same information for segment descriptor sections within the `SegInfo` descriptor file. The `VerifySeg` tool will display these two tables when the `-t` flag is given on the command-line so that the latest information from these two tables is available online.

A `SegInfo` segment section begins with a single line of the form

`[`*`section name`*`]`

where *section name* is chosen from the list in Table 5-5. A section continues until another section name is encountered, or the end of the file is reached. A section may appear only once within the `SegInfo` file, but the order in which sections appear is unimportant. Section names are not case sensitive.

If a section name that the tools do not recognize is encountered, a check is made to see if a helper function is available to process the section. If so, the helper function is invoked, otherwise an error is issued. Appendix C describes which tools accept helper functions. Creation of a helper functions require authorization by the DII COE Chief Engineer.

Descriptor File	COTS	Acct Grp	S/W	Data	DB	Patch
DEINSTALL	O	O	O	O	O	O
FileAttribs	O	O	O	O	O	O
Installed	I	I	I	I	I	I
PostInstall	O	O	O	O	O	R
PreInstall	O	O	O	O	O	O
PreMakeInst	O	O	O	O	O	O
ReleaseNotes	R	R	R	R	R	R
SegChecksum	I	I	I	I	I	I
SegInfo	R	R	R	R	R	R
SegName	R	R	R	R	R	R
Validated	I	I	I	I	I	I
VERSION	R	R	R	R	R	R

R - Required O - Optional N - Not Applicable
I - Created by Integrator or Installation Software

Table 5-4: Segment Descriptor Files

Section	COTS	Acct Grp	S/W	Data	DB	Patch
AcctGroup	N	R	N	N	N	N
*AppPaths	N	O	O	N	N	N
COEServices	O	O	O	O	O	O
Community	O	O	O	O	O	O
Comm.deinstall	O	O	O	O	O	O
Compat	O	O	O	O	O	N
Conflicts	O	O	O	O	O	O
Data	N	N	N	R	N	N
Database	N	N	O	N	R	O
+DCEDescrip	O	N	O	N	N	N
Direct	O	O	O	O	O	O
FilesList	R	O	O	O	O	O
Hardware	R	R	R	R	R	R
Help	O	O	O	O	O	O
Icons	O	R	O	N	N	O
Menus	O	R	O	N	N	O
Network	N	N	N	N	N	N
Permissions	N	O	O	N	N	O
Processes	O	O	O	N	N	O
*Registry	O	O	O	O	O	O
+ReqrdScripts	N	R	O	N	N	N
Requires	O	O	O	O	O	O
Security	R	R	R	R	R	R
SharedFile	O	O	O	N	N	O

R - Required O - Optional N - Not Applicable
*** - NT platforms only + - Unix platforms only**

Table 5-5: SegInfo Segment Descriptor Sections

Certain general characteristics are common to all files or sections listed in these two tables:

1. All descriptor files are ASCII data files. Regardless of platform, the descriptor files may have an optional file extension. The `.TXT` file extension is permitted for each descriptor file except `DEINSTALL`, `PostInstall`, `PreInstall`, and `PreMakeInst`. These are actually executables and may have a `.BAT` extension (for batch files), a `.EXE` extension (for compiled code), or no extension at all. The file extensions are optional, but developers should conform to standards on the platform for which the segment is targeted.

2. In describing syntax, options which may appear exactly once are delimited by brackets (i.e., "[ ]"), while options that may appear multiple times are delimited by braces (i.e., "{ }"). The "|" (boolean exclusive or) symbol is used to indicate a selection of one item from a list of choices. The delimiters are not entered into the actual descriptor file.

3. Descriptor files may contain comments. Comments are delimited by using either the standard C convention[16] (e.g., delimited by /* */), or on a line by line basis using the # character. *C style comments may not be nested.* C style comments may not be used in `PostInstall`, `PreInstall`, `PreMakeInst`, or `DEINSTALL` since these are executable scripts. (These may also be compiled programs instead of scripts, although scripts are recommended because they can be examined at integration time for potential problems.)

4. Blank lines may be used freely and are ignored unless they are within a block of text for insertion, replacement, etc. Blank lines are ignored when searching for a block to delete or replace. Similarly, blanks, tabs, and other whitespace are ignored unless they are part of a block to insert or replace.

5. When a block of text is required, such as in adding a block of text to a community file, the characters "{" and '"}" are used as block delimiters.

6. Keywords inside a descriptor file are always prefixed with the "$" character.

7. C style `#ifdef`, `#else`, `#elif`, `#endif`, and `#ifndef` constructs may be used in descriptor files, along with the standard C boolean operators. These constructs may not span segment descriptor sections. The constants which may be used in these constructs are defined in subsection 5.3.

[16] This should not be misunderstood as stating a preference for C/C++ over Ada or any other language. The comments referred to are placed in data files, not executable code. C style comments were selected because they allow a block of text to be commented out by surrounding the block with a single "/* */" pair instead of including a comment token on each line.

8. During installation, the COE installation software sets up to five environment variables: `INSTALL_DIR` is the absolute pathname to where the segment will be loaded (`PreInstall`) or was loaded (`PostInstall`). `MACHINE_CPU` and `MACHINE_OS` are set to describe the type of platform on which the software has been loaded. Valid values for these environment variables are listed in subsection 5.3. `SYSTEM_ROOT` (for NT only) is set to point to the directory where Windows is installed. `COE_TMPSPACE` is the location of temporary space allocated for the duration of segment installation.

9. Parameters which follow a keyword are given on the same line as the keyword and are separated by colons. The exception to this rule is when the keyword signals the beginning of a variable length list. For example,

   ```
   $PATH:/etc
   ```

   specifies a pathname while

   ```
   $LIST
   f1
   f2
   f3
   ```

   specifies a list of files.

10. Some segment descriptors, such as the `Requires` descriptor, specify the name of another segment that the COE installation tools must search for at install time. To speed up the search process, segment names are expressed in the form

    ```
    segment name:prefix:home dir:[version:{patches}]
    ```

    where *segment name* is the name of the segment, *prefix* is the segment's prefix, *home dir* is the segment's expected home directory, while *version* and *patches* are optional. *home dir* is searched first, and if the segment name found there is the same as that specified, a match is declared successful. If *home dir* does not exist, is not a segment, or the segment name does not match, an exhaustive search is performed on all segments on all mounted disk partitions.

11. (NT) When a disk drive needs to be specified in a filename, the filename must be enclosed in double quotes. This is required so that the tools can distinguish between use of ':' as a field delimiter for descriptors, or as a separator between a disk drive name and a pathname.

12. Some segment descriptors allow a version number or patch level to be specified. See the previous `Requires` example. If no version number is specified, any version found is successful. If a version number is specified, an ordinary lexical comparison of primary version numbers is made with zeroes inserted for any missing digits. For

example, a version number such as 3.4/SunOS-4.1.3 is truncated to just the primary version number which is then expanded to be 3.4.0.0 for comparison purposes.

13. Some descriptor file features require prior Chief Engineer approval, or are restricted to COE-component segments. These are described in the sections which follow and generally require the `$KEY` keyword to be specified in the applicable section. This keyword requires an authorization key provided by the Chief Engineer. The authorization key is based on several segment attributes including segment name, segment prefix, and the section name to which it applies. The format of the `$KEY` keyword is

    ```
    $KEY:permit requested:authorization key
    ```

    where *permit requested* is the keyword or section name the key applies to, and *authorization key* is the key given to the developer by the Chief Engineer. A separate authorization key is required for **each** permit requested.

14. Certain keywords or section names may be applicable to one platform but not another. These are noted in the discussion below. If the tools encounter a keyword that is not appropriate for a platform, a warning will be generated and the keyword or section will be ignored.

15. A segment is considered to be a permanent segment if the `DEINSTALL` descriptor is not provided. This means that the installation tools will prevent a permanent segment from being deleted, but it may be upgraded by loading a newer version of the segment.

DII compliance requires the following:

- Segments shall include all required files shown in Table 5-4. (`VerifySeg` will fail a segment that does not include a required descriptor file.)

- Segments shall fully specify all dependencies and conflicts through the `Requires` and `Conflicts` descriptor files. (Circular dependencies are not allowed.)

- Segments shall fully specify disk and memory requirements (memory may be omitted for data segments) in the `Hardware` file.

- Segments shall not use `PostInstall`, `PreInstall`, `PreMakeInst`, or `DEINSTALL` to make modifications that the COE installation software will make. Of particular importance is that segments shall not delete the segment directory during a `DEINSTALL` script.

- Segments shall use the `ReleaseNotes` file to convey information meaningful to an operator, not the system integrator. `ReleaseNotes` files shall not include company names, names of individuals, nor software trouble report numbers.

- Segments shall specify a version number and date in the `VERSION` descriptor file and shall increment the version number for each subsequent release. Version numbers shall fully comply with the requirements stipulated in Chapter 3 of this document.

5.5.1 AcctGroup

Syntax for the `AcctGroup` descriptor is

```
group name:group ID:shell:profile flag:home dir:default profile name
```

where

group name is an alphanumeric string used to identify this account group. The account group name must be unique (i.e., no other account group may have the same name).

group id is a Unix group id to be inserted into the password file for accounts created from this group. The user id is calculated automatically by examining the password file for user accounts within the same group and then adding 1 to the highest user id. Group ids less than 100 should be avoided.

shell is the Unix shell to execute when logging in (e.g., `/bin/csh`, `/bin/sh`). This parameter should be left blank for NT platforms.

profile flag is 0 if no profiles are allowed, otherwise 1.

home dir is the home directory for the given account group (e.g., `/h/AcctGrps/SecAdm`).

default profile name is an alphanumeric string identifying the account group's default profile. This name is ignored unless the profile flag is nonzero.

In effect, `AcctGroup` is a template of what to enter into the `/etc/passwd` file for accounts within this group.

Group names and profile names are not case sensitive. The maximum number of characters in a group name, including embedded blanks, is 15. The maximum number of characters in a profile name[17] is 64. The maximum number of characters in the home directory pathname is 256.

If the account group is to have a default profile, the installation software will automatically create the profile with the name specified. The profile will be set up to have a classification level of TOP SECRET (unless the segment specifies otherwise), all possible object permissions enabled (see the `Permissions` descriptor), and all possible menu and icon

[17] The maximum in the previous *I&RTS* was limited to 15 characters. This has been extended to support those services which describe profiles based on a combination of duty position and organization, or similar approach.

entries enabled. Note that site administrators will not normally assign the default profile to any user because it would provide greater access than is warranted either from a "need to know" perspective, or from a perspective of overwhelming the operator with too many features. The default profile is provided only as a convenient template for creating user profiles.

The profile classification can be explicitly stated by including a line of the form

```
$CLASSIF:classification
```

in the descriptor file. Valid classification values are

UNCLASS
CONFIDENTIAL
SECRET
TOP SECRET

5.5.2 AppPaths (NT Only)

The `AppPaths` segment descriptor is used to add a list of executables and DLLs to the NT search path. The executables are listed immediately after the segment descriptor as in

```
[AppPaths]
app1.exe
app2.exe
app3.DLL
```

The executables and DLLs must be in the segment's `bin` subdirectory.

The installation tools remove the named executables and DLLs from the NT search path when the segment is deleted. Refer to subsection 5.5.34 for more information on shared files.

> **Note:** As with Unix, it is a violation of the COE to use this technique to insert the current working directory into the NT search path.

5.5.3 COEServices

Segments frequently require changes to services provided by the operating system. Make such requests through the `COEServices` descriptor to ensure proper coordination with other segments. One or more entries may follow each keyword below.

`$GROUPS` (Unix only)

Segments may add entries to the `/etc/group` file as follows:

```
$GROUPS
name:group id
```

where *name* and *group id* have the meaning defined by the Unix `group` file. If the specified name already exists in the group file but with a different group id, an error will be generated.

`$PASSWORDS` (Unix only)

Segments may occasionally need to add entries into the Unix password file to establish file ownership. The syntax is:

```
login name:user id:group id:comment:home dir:shell
```

where these entries correspond to the entries in the Unix `passwd` file. Multiple lines may be included to add multiple password entries.

The installation software inserts an "*" for the password field to ensure that these are system accounts, not actual login accounts. Segments that need to add a user account must be approved in advance by the Chief Engineer, and then will generally be approved only for COE-component segments.

The installation software processes the `$PASSWORDS` keyword *before* the segment is actually loaded onto disk so that `PostInstall` scripts which need to set file ownership will work properly.

`$SERVICES`

Ports are added to the `/etc/services` (or NT equivalent) system file through the `$SERVICES` keyword. The syntax is:

```
$SERVICES[:comment]
name:port:protocol{:alias}
```

where

name is the name of the socket to add,

port is the port number requested, and

protocol is either `tcp` or `udp`.

The optional *comment*, if provided, will be inserted into the `/etc/services` file by the installation software.

If the port number requested is already in use under another name, an error will be generated. Note that port numbers in the range 2000-2999 are reserved for COE segments.

This keyword should not be necessary for most DCE applications because endpoints are defined dynamically.

5.5.4 Community

Many of the descriptor files direct the installation software to insert, delete, replace or otherwise alter blocks of text in ASCII files. The `Community` descriptor file is provided to issue similar commands to the installation software for which no corresponding descriptor file exists. It is intended to be a "catch all" and should be used carefully, and only when there is no other way to accomplish the modifications required. `VerifySeg` will fail any segment which attempts to use a `Community` descriptor file to modify a file that is already handled by another descriptor file.

Segment developers shall use the `Comm.deinstall` descriptor file to undo changes made by the `Community` file. `Comm.deinstall` is invoked when a segment is removed, and is essentially a reverse image of the `Community` file. The `Comm.deinstall` is neither required nor useful if the segment is a permanent segment.

The commands listed below are available for both the `Community` and `Comm.deinstall` files. Blocks of text are delimited by braces, where the opening and closing brace are on a line by themselves. When commands require that a textual search be done, embedded spaces and control characters are ignored during the search.

To illustrate how the commands work, assume the file `IDE.TEST` contains the following text:

```
# Sample file

# Define runtime vars
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data

# set a test var
setenv testvar $HOME

set filec

setenv testvar2 $HOME/data

# end of example file
```

`$APPEND`

Append the block of text which follows to the end of the file.

Example:

```
$APPEND
{
# This is an example to append at the end of a file
source my_script
#
}
```

$COMMENT:char

Using the character specified, find the block of text which follows and comment it out. This effectively deletes text, but has the advantage that it can easily be uncommented.

The command sequence

```
$COMMENT:#
{
# set a test var
setenv testvar $HOME
set filec
}
```

will replace the text to modify the file as follows:

```
# Sample file

# Define runtime vars
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data

## set a test var
#setenv testvar $HOME
#
#set filec

setenv testvar2 $HOME/data

# end of example file
```

Notice that the blank line between `setenv` and `set` is ignored in searching for the lines to delete, but is preserved in the commented out version of the file.

> **Note:** Be careful to note that the '#' character is not a valid comment delimiter for all community files! (e.g., X and Motif resource files use '!' as a comment delimiter.)

$DELETE [ALL]

Find the block of text which follows and delete it from the file. If ALL is specified, delete every occurrence in the file.

The command sequence

```
$DELETE
{
# set a test var
setenv testvar $HOME
set filec
}
```

will delete the block of text to modify the file as follows:

```
# Sample file

# Define runtime vars
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data


setenv testvar2 $HOME/data

# end of example file
```

Notice that the blank line between setenv and set is ignored in searching for the lines to delete, but is deleted in the resulting version of the file.

$FILE:filename

Name the file to which the commands that follow apply.

Example:

```
$FILE:/h/IDE/Scripts/IDE.JMCIS
```

$INSERT [ALL]

Find the first occurrence of the first block of text, then insert the second block of text immediately after it. If ALL is specified, insert the second block of text after every occurrence.

Example:

```
$INSERT
{
setenv OPT_DATA $OPT_HOME/data
}
{
setenv OPT_BIN $OPT_HOME/bin
setenv OPT_SRC $OPT_HOME/src
}
```

The resulting changes to the example file are:

```
# Sample file

# Define runtime vars
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data
setenv OPT_BIN $OPT_HOME/bin
setenv OPT_SRC $OPT_HOME/src

# set a test var
setenv testvar $HOME

set filec

setenv testvar2 $HOME/data

# end of example file
```

$REPLACE [ALL]

Replace the first occurrence of the first block of text, if found, with the second. If ALL is specified, replace every occurrence.

Example:

```
$REPLACE
{
setenv OPT_HOME /h/OPT
}
{
setenv OPT_HOME /home2/OPT
}
```

Embedded spaces and control characters are ignored in the search, but are preserved in the replacement. Case is preserved in the search and in the replacement.

$SUBSTR:DELETE [ALL] | INSERT [ALL] | REPLACE [ALL]

When performing a textual search, search for a matching substring instead. Insertions, deletions, or replacements are made as indicated.

$UNCOMMENT:char

Find the block of text which follows and uncomment it. The comment character is *char*, but the block of text which follows the `$UNCOMMENT` command does not contain the comment character.

Example (undo the effects of the `$COMMENT` example above):

```
$UNCOMMENT:#
{
# set a test var
setenv testvar $HOME
set filec
}
```

Blank lines will also be uncommented if there are any between

```
# set a test var
```

and

```
set filec
```

Consider a more complete example. The following will insert two new environment variables at the end of the file, replace `OPT_HOME` with `OPTION_HOME`, replace `OPT_DATA` with `OPTION_DATA`, and replace all occurrences of the substring "`stvar`" with "`st_var`". This example also shows the use of comments.

```
/* This is a multi-line comment
 just like in standard C.
*/
# This is a single line comment

# Assume file is in IDE Scripts subdirectory
$FILE:/h/IDE/Scripts/IDE.TEST

$REPLACE
{
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data
}
{
setenv OPTION_HOME /h/OPTION
setenv OPTION_DATA $OPTION_HOME/data
}

$SUBSTR:REPLACE ALL
{
stvar
}
{
st_var
}

$APPEND
{
#-------------------------
# BEGIN xxx modifications
#-------------------------

setenv my_var /h/IDE

#-------------------------
# END xxx modifications
#-------------------------
}
```

The resulting file `IDE.TEST` is

```
# Sample file

# Define runtime vars
setenv OPTION_HOME /h/OPTION
setenv OPTION_DATA $OPTION_HOME/data

# set a test var
setenv test_var $HOME

set filec

setenv test_var2 $HOME/data

# end of example file
#------------------------
# BEGIN xxx modifications
#------------------------

setenv my_var /h/IDE

#------------------------
# END xxx modifications
#------------------------
```

This example shows the use of comments to enclose modifications between a BEGIN/END pair. This technique is recommended when making modifications to community files to make it easier to determine changes made as segments are installed.

> **Note:** This technique is used by the installation software as environment extension files are modified. Therefore, developers must *not* put such comments in environment extension files.

5.5.5 Comm.deinstall

`Comm.deinstall` is the inverse of `Community`. Its purpose is to undo modifications made to community files when a segment is removed from the system.

The corresponding `Comm.deinstall` file to undo the changes made in the example from the `Community` subsection is:

```
$FILE:/h/IDE/Scripts/IDE.TEST
$REPLACE
{
setenv OPTION_HOME /h/OPTION
setenv OPTION_DATA $OPTION_HOME/data
}
{
setenv OPT_HOME /h/OPT
setenv OPT_DATA $OPT_HOME/data
}

$SUBSTR:REPLACE ALL
{
st_var
}
{
stvar
}

$DELETE
{
#-------------------------
# BEGIN xxx modifications
#-------------------------

setenv my_var /h/IDE

#-------------------------
# END xxx modifications
#-------------------------
}
```

5.5.6 Compat

Subsequent releases of a segment are not always backwards compatible. The `Compat` descriptor is used to indicate the degree to which backward compatibility is preserved with the newly released segment. This is achieved by listing version numbers for previous releases which the current release supports. In the sense used here, backwards compatibility means that the segment being released will work with other segments that have been compiled and linked with an earlier release version.

The format of the `Compat` descriptor is a single line containing one of three possible entries:

+ALL This indicates that the current release is backwards compatible with all previous releases.

-NONE This indicates that the current release is not backwards compatible with any previous release.

version list This indicates that the current release is backwards compatible to a list of versions. Version lists are denoted by the `$LIST`, `$EARLIEST`, and `$EXCEPTIONS` keywords.

For example, suppose the new `MySeg` release is version 3.2.5.4 and that it is compatible with all versions from 2.9.1 up to the present with the exception of versions 3.0.1.2 and the 3.1 version series. Then the `Compat` file would contain the following entries:

```
# First number listed is earliest compatible version
$EARLIEST
2.9.1
# Remaining version numbers are exceptions
$EXCEPTIONS
3.0.1.2
3.1
```

When a digit is omitted from the version number, or an asterisk is in place of the digit, there is an assumed wildcard in that digit position. That is, any digits would be acceptable in that position.

The `$LIST` keyword is used to indicate an explicit list of compatible versions. `$LIST` is mutually exclusive with the `$EARLIEST`/`$EXCEPTIONS` keyword pair. When specifying a list, a range can be indicated by the optional keyword `$TO`. Thus, the previous example could also have been done as

```
$LIST
2.9.1 $TO 3.0.1.1
3.0.1.3 $TO 3.0.9
3.2.0 $TO 3.2.5
```

In some cases, one or more patches must be applied to preserve compatibility. The patches are listed by number immediately after the version number by using a colon between patch numbers. This may be done only with the `$LIST` keyword. For example,

```
$LIST
2.9.1:P4:P5
3.0.1.1
3.0.2:P8 $TO 3.0.4:P7
```

This means that the current version is backwards compatible with

- 2.9.1, but only if patches P4 and P5 have been applied
- 3.0.1.1 with no restrictions regarding patches
- 3.0.2 through 3.0.4 with the restriction that patch P8 must be applied to version 3.0.2 and patch P7 must be applied to version 3.0.4.

If no `Compat` file exists, the present version is assumed to not be backwards compatible with any previous releases. That is, `-NONE` is assumed.

5.5.7 Conflicts

Two segments may conflict with one another so that one or the other, but not both, can be installed. The `Conflicts` descriptor is used to specify such inter-segment conflicts. The format is a list of conflicting segments in the form:

```
segment name:prefix:home dir[:version{:patch}]
```

where *segment name* is the name of the conflicting segment as given in the segment's `SegName` descriptor file, *prefix* is the conflicting segment's segment prefix, and *home dir* is the conflicting segment's home directory.

The `Conflicts` descriptor is essentially the converse of the `Requires` descriptor file.

5.5.8 Data

The `Data` descriptor is used to describe where data files are to be logically loaded and their scope (global, local, or segment). Only one of the three scopes may be specified in the descriptor file; that is, a data segment has one and only one scope.

The syntax is

```
$SEGMENT:segname:prefix:home dir
```

for segment data, or

```
$LOCAL:segname:prefix:home dir
```

for local data, or

```
$GLOBAL:segname:prefix:home dir
```

for global data, where *segname*, *prefix*, and *home dir* refer to the affected segment. The *segname* and *prefix* must match the name given in the affected segment's `SegName` descriptor. Figure 5-9 shows that the data to install is underneath the segment's `data` subdirectory.

5.5.9 Database

The `Database` segment descriptor is used to identify information such as object dependencies that are within the database and therefore cannot be resolved without the use of the DBMS. There are five keywords used under this descriptor to track object-level information: `$REFERENCES`, `$MODIFIES`, `$ROLES`, `$SCOPE`, and `$ACCESSES`. The

first four are used by database segments, the last is used by database application segments. Their usage is discussed below.

$SCOPE:*scope*

This keyword specifies the scope of the database objects. Legal values for *scope* are UNIQUE, SHARED, and UNIVERSAL. Scope is required for database segments, but it is not presently used. It is reserved for future use and required now so that segments will not require modifications later.

$REFERENCES

The $REFERENCES keyword is followed by a list of the individual database objects that the database segment depends upon which are external to the segment. The Requires segment descriptor must be used to state a dependency upon the segments whose objects are listed under $REFERENCES. Version compatibility will be checked using the Requires descriptor so it is not repeated here. The format for the object list is

```
$REFERENCES
object name:schema
```

For example, assume that the GSORTS database segment references the COUNTRY_CODE table in the S&M segment and the PORTS table in the NID segment. The DBO accounts for S&M and NID respectively are TABLE_MASTER and NID. The appropriate descriptor is

```
$REFERENCES
COUNTRY_CODE:TABLE_MASTER
PORTS:NID
```

$MODIFIES

The $MODIFIES keyword is followed by a list of the external database objects that the database segment modifies by adding triggers, or by including them in procedures or functions. All segments whose objects are listed here must also appear under the Requires descriptor. The format for the object list is

```
$MODIFIES
object name:schema:modification type:modification name
```

The *object name* and *schema* follow the same rules as the $REFERENCES keyword. *Modification type* is used to stipulate what has been done. Its legal values are TRIGGER for database triggers or PROCEDURE for database functions, procedures, or packages. *Modification name* is the name of the trigger or procedure that is attached to the object. An example follows defining a trigger named GSORTS_NID_COPY that is attached to the NID database's PORTS table.

```
$MODIFIES
PORTS:NID:TRIGGER:GSORTS_NID_COPY
```

$ROLES

The $ROLES keyword is followed by a list of the database roles created by the database segment. Its format is

```
$ROLES
role name
```

An example that defines two roles follows.

```
$ROLES
EWIR_RO
EWIR_DATA1_RW
```

It is recommended that comments be placed in the segment descriptor to describe what these roles are for and how they are intended to be used. This is a convenient place to document such important information.

$ACCESSES

The $ACCESSES keyword is used in a software segment rather than a database segment. It associates individual applications within a software to their supporting database roles. Its format is

```
$ACCESSES
application name:role name:segment name
```

The *application name* is the name of the executable within the segment. *Role name* is the name of the database role used by the application. *segment name* is the name of the database segment that owns that role. That segment will be searched by the installer tool, if necessary, to obtain the DBO account name. An example follows associating the EWIR_WIDE application to the EWIR_RO role.

```
$ACCESSES
EWIR_WIDE.FMX:EWIR_RO:EWIRDB
```

Note: Do not confuse the Database segment *descriptor* with the database segment *type*. The segment descriptor, described in this subsection, describes specialized processing for the COE to perform on a segment which is of segment type ‘database.’

5.5.10 DCEDescrip (Unix Only)

This segment descriptor is used to define characteristics of DCE servers. It is not required for DCE client applications. The associated keywords are used to describe the server.

$DCESERVERS

This keyword is used to list the servers that are provided by the segment (usually only one). The server executables are in the `bin` subdirectory for the segment. The keyword is followed by a list of the server names, interface attributes, security attributes, and configuration attributes. The format is:

SERVER *servicename*:*principal*:*uid*:*gid*:*home*:*starton*

where *servicename* is the name of the service, *principal* is the DCE account for the server, *uid* is the Unix account for the server, *gid* is the Unix group id for the server, and *home* is the Unix home directory for the server. *starton* is one of the following values: `AUTO`, `EXPLICIT`, `BOOT`, `FAILURE`.

Interface attributes are listed in the form:

INTERFACE *servicename*:*interfacename*:*UUID*

where *servicename* is the name of the service implementing this interface, *interfacename* is the name of the interface, and *UUID* is the universal unique id assigned to this interface.

Interface security attributes are listed in the form:

RPCSECURITY *servicename*:*interfacename*:*security*

where *servicename* is the name of the service implementing this interface, *interfacename* is the name of the interface, and *security* is the maximum security supported by the server.

Extended configuration attributes are listed in the form:

CONFIG *servicename*:*attribute*:*scope*:*UUID*

where *servicename* is the name of the service implementing this interface, *attribute* is the name of the attribute in the extended schema, *scope* is the scope of the attribute (either `COE` or `SERVER`), and *UUID* is the unique object id for the attribute.

$DCEBOOT
$DCEDEMAND

These two keywords are used to designate processes that are to be started by `dced`. The format for the list of processes is the same as for processes listed in the `Processes`

segment descriptor (see subsection 5.5.25). $DCEBOOT indicates that dced starts the processes at boot time while $DCEDEMAND indicates that they are started on demand.

$DFSFiles

This keyword is similar in purpose to the FilesList segment descriptor (subsection 5.5.14). It is used instead of FilesList because the files listed are maintained by DFS, not by the native operating system. The keyword is followed by a list of filenames in the form:

filename access

where *filename* is the DFS filename used by the application, and *access* indicates the operations performed on the file (RWX). All file names shall start with /.../cellname/fs/.

$KEY:DCE:*key*

All boot time processes, including those started by dced, require approval by the Chief Engineer. Therefore, the $DCEBOOT keyword must include the $KEY keyword as well. *key* is the authorization key provided by the Chief Engineer and it applies to all servers within this segment.

There are some important things to note about DCE servers.

- Use $DCEServers instead of the $SERVERS keyword (Network descriptor) to define DCE-based servers.
- Document DFS files with the $DFSFiles keyword.
- Include a $PASSWORDS entry in COEServices to establish a Unix userid for each server principal.
- Developers should normally provide a single DCE server in a segment. It would be unusual to need to provide more than one.

5.5.11 DEINSTALL

The DEINSTALL descriptor file is an executable, either a script or a compiled program, that is invoked by the installation software when the operator has elected to remove a segment. This may occur by explicitly selecting a segment to remove or by electing to install a new version of the segment. DEINSTALL should perform actions such as shutting down segment-owned background processes prior to segment removal. Operations performed in preparation for a segment update should normally be done in PreInstall, while DEINSTALL is used when the segment is to be "permanently" removed from the system.

If this file does not exist, the segment is assumed to be permanent and cannot be removed except when installing a new version. If a new version is installed and this file does not exist, the installation software will use the information in the descriptor directory to undo changes made by the previous installation of the segment and then simply delete the directory.

For security reasons, the `DEINSTALL` script is not run with root-level privileges, unless the `$ROOT` keyword is given in the `Direct` descriptor, described below. Note that the `$KEY` keyword must also be specified in the `Direct` descriptor to acquire root-level privileges.

5.5.12 Direct

The segment descriptor `Direct` allows a segment to issues special instructions to the installation tools. If the segment is part of an aggregate, the directives below apply *only* to the segment in whose `SegDescrip` subdirectory the directives appear.

`$ACCTADD:executable`

This keyword informs the installation software that the specified *executable*, in the segment's `bin` subdirectory, should be run each time a user account is added to the system. `VerifySeg` will flag use of this keyword as a warning to highlight that it is being used. Prior permission must be given by the Chief Engineer before this keyword can be used.

`$ACCTDEL:executable`

This keyword informs the installation software that the specified *executable*, in the segment's `bin` subdirectory, should be run each time a user account is deleted from the system. `VerifySeg` will flag use of this keyword as a warning to highlight that it is being used. For security reasons, prior permission must be given by the Chief Engineer before this keyword can be used.

`$CMDLINE`

Segments which provide a command-line access must insert this keyword in their segment.

`$KEY:`*`request`*`:`*`key`*

Several of the keywords presented here require authorization by the Chief Engineer. Thus, `$KEY` must be provided for each requested permission. *key* is the authorization key provided by the Chief Engineer. *request* is an indication of the type of request being made. Requests are grouped by the type of request being made (e.g., security-related, installation-related) and are one of the following values:

INSTALL	for permission to run PostInstall, PreInstall, and DEINSTALL with root permission
ACCTS	to use any of the account creation/deletion keywords (e.g., for $ACCTDEL, $ACCTADD, $PROFADD, $PROFDEL, and $PROFSWITCH)
CMDLINE	to use the $CMDLINE keyword
SUPERUSER	to use the $SUPERUSER keyword

A separate authorization key and $KEY entry is required for *each* request group, but the key applies to any and all requests within that group.

$NOCOMPRESS

The MakeInstall tool automatically compresses segments to reduce the amount of space required on disk or tape, and to reduce the download time. The installation tools automatically decompress segments at installation time. The $NOCOMPRESS keyword indicates that compression is *not* to be performed.

$PROFADD:executable

This keyword operates in the same fashion as $ACCTADD, except that it is used when profiles are added to the system.

$PROFDEL:executable

This keyword operates in the same fashion as $ACCTDEL, except that it is used when profiles are added to the system.

$PROFSWITCH:executable

This keyword is similar to $PROFADD except that the executable is run whenever a user currently logged in switches from one profile to another. The executable is *not* run when the user first logs in; it is run only when a profile switch is made.

$REBOOT

The presence of this keyword indicates that the installation software should automatically reboot the computer after the segment is loaded. If several segments have been selected for loading at one time, the reboot operation will not occur until all segments have been processed. The operator will be notified before the reboot occurs and given the option to override the reboot directive.

$REMOTE[:XTERM | :CHARBIF]

This keyword indicates that the functions (*all* functions) provided by this segment can be executed remotely. At installation time, the installation software will note that this

segment can be executed remotely. If the XTERM attribute is present, it indicates that the segment can also be accessed via an "xterm" capability, and output will be routed to the display surface pointed to by the DISPLAY environment variable setting. If the CHARBIF attribute is present, it indicates that the segment supports a character-based interface. CHARBIF and XTERM will normally be mutually exclusive.

By default, segments are assumed to be locally executable only.

$ROOT:PostInstall | PreInstall | DEINSTALL

The presence of this keyword indicates that the specified descriptor must be run with root privileges. A separate $ROOT entry is required for each descriptor. VerifySeg will flag use of this keyword as a warning to highlight that it is being used. For security reasons, prior permission must be given by the Chief Engineer before this keyword can be used. $ROOT requires the $KEY keyword as well.

$SUPERUSER

Segments which provide or require superuser privileges, via a command-line or otherwise, must insert this keyword in their segment. Note that the $KEY keyword must also be used to verify that Chief Engineer approval has been obtained.

5.5.13 FileAttribs

The FileAttribs descriptor allows a segment to specify the attributes (owner, read/write permissions, group) for each file in the segment. It is created by the tool MakeAttribs (see Appendix C). The installation tools, just prior to PostInstall, will use information in this file to set file attributes.

FileAttribs has certain restrictions due to security and segment integrity considerations. The following will be ignored:

- Files within the SegDescrip subdirectory
- Files outside the segment
- Requests to set root ownership
- Requests to set Unix "sticky bits" (e.g., chmod 4644)

If FileAttribs is not provided by the segment, the installation tools will automatically do the following for all except COTS segment types:

- chmod 554 for all files in the bin subdirectory
- chmod 664 for all files in the data subdirectory
- for account groups, set owner to the same group id as specified in the AcctGrps descriptor for all subdirectories except SegDescrip
- for other segment types, set owner to the same group id as the affected segment for all subdirectories except SegDescrip.

5.5.14 FilesList

`FilesList` is a list of files and directories that make up the current segment. It is required for COTS segments. For other segment types, it is useful for documenting community files modified or used by the segment. The reason that this descriptor is required for COTS segments is that COTS products do not usually conform to the DII-mandated directory structure. Therefore, the location of files modified by or contributed by the segment is not usually readily apparent.

`FilesList` may contain the following keywords:

`$DIRS` a list of directories which this segment adds to the system. All files in the directory are assumed to belong to the segment.

`$FILES` a list of files which this segment adds to the system.

`$PATH` a shortcut for specifying a pathname. Succeeding `$DIRS` or `$FILES` are relative with respect to the path specified.

A keyword must precede any list so that it will be clear whether a directory or a file is intended.

As an example, assume a segment to be installed creates the following four subdirectories

```
/h/data/test/data1
/h/data/test/data2
/h/data/opt/data3
/usr/opt/temp
```

and adds three files (`f1`, `f2`, `f3`) to the `/etc` subdirectory. Then the file `FilesList` could contain the following entries:

```
$PATH:/h/data
$DIRS
test/data1
test/data2
opt/data3
$DIRS
/usr/opt/temp
$PATH:/etc
$FILES
f1
f2
f3
```

The `$DIRS` keyword before `/usr/opt/temp` is not necessary, but is shown to illustrate that `FilesList` may contain multiple occurrences of the keywords.

For COTS products, this descriptor must be used to list:

1. all files and directories the product adds that lie outside the segment's assigned directory, and
2. any community file the COTS product modifies unless the modification is made by the COE installation tools.

For example, assume a COTS segment adds a port to `/etc/services` through the `COEServices` segment descriptor. Further, assume that the vendor provides a program that directly modifies the `/etc/group` file as part of the installation process. Then `FilesList` must list `/etc/group` but does not need to include `/etc/services` because the installation tool modifies it as a result of the `COEServices` descriptor.

5.5.15 Hardware

The `Hardware` descriptor defines the computing resources required by the segment. Keywords `$CPU` and `$MEMORY` may appear only once; both are required for all segments, except that `$MEMORY` may be omitted for a data segment. `$DISK` and `$PARTITION` are mutually exclusive, but one must appear in the segment descriptor. `$DISK` may appear only once, but `$PARTITION` may appear multiple times. `$OPSYS` and `$TEMPSPACE` are optional.

`$CPU:platform | ALL`

platform is one of the supported platform constants listed in subsection 5.3 for `MACHINE_CPU`, or `ALL`. If `ALL` is given, it indicates that the segment is hardware independent (e.g., a data segment). If platform is a generic constant (e.g., HP or PC), it applies to all platforms of that class. Thus,

```
$CPU:PC
```

indicates that the software can be loaded on any PC, whether the PC is a 386, 486, or Pentium class machine. However,

```
$CPU:PC386
```

indicates that the software can be loaded on a 386 or better class platform. Similarly, HP712 indicates that the software can be loaded on an HP712 or better class platform that is binary compatible with the HP712.

`$DISK:size[:reserve]`

size is expressed in kilobytes and is the size of the segment, including all of its subdirectories, at install time. The COE tool `CalcSpace` (see Appendix C) will compute the disk space occupied by a segment and update this keyword. *reserve* is also expressed in kilobytes and is the *additional* amount of disk storage to reserve for future segment growth.

$MEMORY:size

size is expressed in kilobytes of RAM required.

$OPSYS:operating system | ALL

operating system is one of the supported platform constants listed in subsection 5.3 for MACHINE_OS, or ALL. If ALL is given, it indicates that the segment is operating system independent. Dependencies on a particular version of the operating system are defined in the Requires descriptor where a dependency on a specific segment (e.g., operating system with a particular version) is described.

$PARTITION:diskname:size[:reserve]

This keyword allows segments to reserve space on multiple disk partitions. The installation software will not split a segment across disk partitions, but the segment may do so in a PostInstall script. Use of multiple disk partitions is discouraged.

size and *reserve* have the same meanings as for $DISK. For Unix platforms, *diskname* is either an explicit partition name (e.g., /home2) or an environment variable name of the form DISK1, DISK2, ... DISK99. The installation software will set the environment variables DISK1, DISK2, etc. to the absolute pathname for where space has been allocated. These environment variables are defined for PreInstall and PostInstall, but not for DEINSTALL. $PARTITION keywords are assumed to be in sequential order, so that environment variable DISK1 will refer to the first keyword encountered, DISK2 to the second, etc.

For NT platforms, *diskname* must be a disk drive name. For example,

```
$PARTITION:"D:":2048
```

requests 2MB of space on the "D" disk drive.

For example, suppose a TDA is compiled to run on an HP, a Solaris, and an NT workstation. Assume for the HP it requires 512 K of memory, requires 1 MB of disk storage for the program and its data files, and will expand over time to a maximum of 4 MB. For Solaris, assume it requires 576 K of memory, 1.5 MB for initial disk space, and will expand to 5 MB. For a PC, assume the requirements are the same as for the Solaris machine. The proper Hardware file is

```
#ifdef HP
   $CPU:HP
   $DISK:1024:3072
   $MEMORY:512
#elif SOL
   $CPU:SOL
   $DISK:1536:3584
   $MEMORY:500
#elif PC && NT
   $CPU:PC486
   $DISK:1536:3584
   $OPSYS:NT
   $MEMORY:571
#endif
```

Note that this example indicates that the information described is the same for all HP platforms, the same for all Solaris platforms, but that it only applies to PC486 or better machines running Windows NT.

As another example, assume a data segment is to be allocated across three disk partitions. Further assume that the first partition must be `/home5` and requires 10 MB, but the remaining space required is 20 MB each and can be on any available disk partition. The proper `$PARTITION` statements are:

```
$PARTITION:/home5:10240
$PARTITION:DISK2:20480
$PARTITION:DISK3:20480
```

Assume that the installation software is able to allocate space on `/home5` as requested, and that the remainder of the space requested is on `/home18`. The installation software will set the following environment variables:

```
setenv DISK1      /home5
setenv DISK2      /home18
setenv DISK3      /home18
```

`$TEMPSPACE:size`

Some segments may need temporary space during the installation process. The `$TEMPSPACE` keyword requests that *size* kilobytes of disk space be allocated for temporary use during the installation process. If space is available, the installation software sets the environment variable `COE_TMPSPACE` to the absolute path where space was allocated. If space is not available, an error message is displayed to the operator and the segment installation fails. The installation software automatically deletes the allocated space when segment installation is completed. Space is allocated prior to executing `PreInstall`.

5.5.16 Help

This segment descriptor is a place holder for a future COE revision. Its purpose is to provide a mechanism for identifying and managing help files within the system. Segment developers should use this descriptor now to reduce migration problems later.

As Figure 5-2 indicates, segment help files are located directly underneath the directory

SegDir/data/Help

They are listed individually in the Help segment descriptor and grouped according to their format. Help file format is identified by one of the following keywords:

$HTML a list of help files in HTML format.

$MAN a list of help files in Unix man page format.

$MSHELP a list of help files in Microsoft Help format (NT only).

$TEXT a list of help files in plain ASCII text format (i.e., no graphics or special characters).

$OTHER a list of files in a format other than that identified by the preceding keywords.

The order in which these keywords is listed is not important and they may be repeated multiple times within the segment descriptor. HTML is the COE-standard format, but the other formats are provided to assist legacy system migration.

For example, assume a segment contains two HTML-format help files (H1 and H2), Unix man pages (man1 and man2), three ASCII text files (T1, T2, and T3), and one help file in an internal format (doc1). Then the proper Help segment descriptor entries are:

```
[Help]
$HTML
H1
H2
$MAN
man1
man2
$TEXT
T1
T2
T3
$OTHER
doc1
```

5.5.17 Icons

The `Icons` descriptor is used to define the icons that are to be made available on the desktop to launch segment functions. The format of the descriptor is a list of files underneath `data/Icons` that define icon bitmaps and their associated executables. Refer to the Executive Manager API documentation for a description of the file format.

5.5.18 Installed

The installation software creates the file `Installed` as segments are loaded. The file specifies the segment that was loaded, the date and time of the installation, which workstation was used to do the installation, and the version number of the software used to do the installation. This file is located underneath the segment descriptor directory.

5.5.19 Menus

Use the `Menus` descriptor to list the names of menu files contained within the segment. Figure 5-2 shows that segment menu files are located underneath `data/Menus`. Refer to the Executive Manager API documentation for the menu file format.

For account groups, this descriptor is simply a list of the account group's menu files. For other segments, the format of each line is

```
menu file[:affected menu file]
```

where *menu file* is the name of a menu file underneath the segment's `data/Menus` subdirectory, and *affected menu file* is the account group menu file to update. If multiple account groups are affected, as listed in the `SegName` descriptor, each affected account group is updated. If no affected menu file is listed, then menu file is simply added to the list of menu files which comprise the account group's menu templates.

For example, suppose a segment called `ASWTDA` has four menu files in the `data/Menus` subdirectory: `System`, `MoreStuff`, `ASWTDA`, and `Logging`. Assume that `System` is to be added to the affected account group's `System` menu file, and `MoreStuff` is to be added to the affected account group's `Default` menu file. The proper entries are as follows:

```
System:System
MoreStuff:Default
ASWTDA
Logging
```

5.5.20 Network

The `Network` descriptor is used to describe network-related parameters. Use of this descriptor requires prior approval by the DII COE Chief Engineer and its use is restricted to COE-component segments, except for DCE Servers which are not necessarily COE-

component segments. VerifySeg will strictly fail any segment that includes this descriptor unless it is a COE-component segment or it is a DCE server (e.g., the DCEDescrip is provided in the segment's SegInfo file).

One or more entries may follow each keyword listed below.

$HOSTS

IP addresses and hostnames are generally established by a system or network administrator. Segments may add IP addresses and host names as follows:

```
$HOSTS
LOCAL | REMOTE :IP address:name{:alias}
```

where *IP address*, *name*, and *alias* are as defined for the Unix /etc/hosts file. If the IP address specified already exists in the network hosts file, the name and alias entries are added as alias names. If LOCAL is specified, the entry is made only to the local network hosts file. If REMOTE is specified, the entry is applied to the NIS/NIS+ or DNS server. If REMOTE is specified but neither NIS/NIS+ or DNS are installed, it will default to LOCAL.

Segments should rarely need to directly add host table entries. VerifySeg will issue a warning for any segment which adds host table entries.

$KEY:Network:key

key is the authorization key given to the segment developer by the Chief Engineer. This entry is required only once within the section, and it applies to all entries within the section.

$MOUNT (Unix only)

The $MOUNT keyword is used to specify NFS mount points. The syntax is

```
hostname:NFS mount point:target dir
```

where *hostname* is the name of a workstation on the network, *NFS mount point* is the file partition to mount, and *target dir* is where to mount the requested partition on the local machine. If target dir does not exist on the local machine, it will be created.

For example, the sequence

```
$MOUNT
dbserver:/home3/USERS:/h/USERS
```

will perform the Unix equivalent of

```
mount dbserver:/home3/USERS /h/USERS
```

If the hostname specified is the same as the local machine, a mount is not performed. Instead, the NFS mount point is made available for other workstations to mount. If a mount is performed as a result of processing this keyword, the system will automatically reboot the system after segment installation is completed. It performs as if the `$REBOOT` keyword (see the `Direct` descriptor) were encountered; that is, the operator is notified that a reboot is required and given an option to override the reboot directive.

`$NETMASK:mask`

This keyword allows a COE-component segment to set the subnet mask to *mask*. This should rarely be required since the netmask is normally established as part of the kernel COE. If two COE-component segments attempt to set the netmask, the last segment loaded succeeds.

`$SERVERS`

Most COE services are implemented as servers. This keyword allows a segment to list the servers, by symbolic name, that it contains. These servers are registered with the COE so that other segments can obtain their location through the `COEFindServer` function (see Appendix C).

> **Note:** Servers implemented through DCE functions should not use this keyword. The `$DCESERVERS` keyword should be used in the `DCEDescrip` segment descriptor.

Each name listed is added to a table maintained by the COE of all servers in the system. This table is used by the System Administration software to allow a site administrator to indicate which platform actually contains the server. The name given is added as an alias to the network host table for the workstation that contains the server. If NIS/NIS+/DNS are being used, the alias is added to the NIS/NIS+/DNS-managed host table. Otherwise, it is added to `/etc/hosts`.

For example, assume a COE-component segment contains two servers named `masterTrk` and `masterComms`. Assume that this segment is loaded on two workstatations: `sys1` and `garland`. Some servers are designed to recognize whether they are the master server or are a slave to a master server located elsewhere. For this reason, the COE must handle situations where the same segment is loaded on a server and a client machine. Assume in this example that the segment operates as a master server on `sys1`, but as a slave on `garland`.

The following statements identify the servers contained within this segment:

```
$SERVERS
masterTrk
masterComms
```

When the segment is loaded, the installation software performs the following actions:

1. Add `masterTrk` and `masterComms` to the COE-maintained list of servers if they are not already there.
2. Check to see if `masterTrk` or `masterComms` already exist in the network host table. If so, processing is completed.
3. Otherwise, ask the operator if this is the server platform for `masterTrk` and `masterComms`.
4. If the operator answers "no" to the previous question, processing is complete.
5. If the answer is "yes," update the network host table to contain `masterTrk` and `masterComms` as aliases for the machine being loaded.

Note that this approach does not require the server (`sys1`) to be loaded prior to the client (`garland`). Furthermore, the site administrator can later change the configuration because all necessary information is available to the System Administrator software. Also note that the segment does not require the actual hostnames or IP addresses.

Hostnames are site-specific and cannot be predicted in advance. Therefore, the COE requires that segments use meaningful symbolic names as illustrated here instead of making assumptions about a specific hostname or naming convention.

5.5.21 Permissions

The Security Administrator software provides the ability to describe objects (files, data fields, executables, etc.) which are to be protected from general access. This information is used to create profiles which limit an operator's ability to read or modify files. Applications may query the security software to determine the access permissions granted to the current user. The `Permissions` file is the mechanism by which segments describe objects and what permissions to grant or deny for the objects.

This descriptor is a sequence of lines of the form:

```
object name:permission abbreviation:permission
```

object name is the item to be controlled, *permission* is the type of access to grant or deny (add, delete, read, etc.), and *permission abbreviation* is a single character abbreviation for the permission.

Permission abbreviations specified for an account group must agree with all segments which become part of the group. The following are reserved abbreviations and their meanings:

A - Add
D - Delete
E - Edit
P - Print
R - Read
V - View
X - Transmit

Segments may use additional abbreviations as required.

For example, suppose a segment generates reports that are to be protected. Permissions relevant to reports are delete, print, read, and archive. The proper `Permissions` file is:

```
Reports:D:Delete:P:Print:R:Read:Z:Archive
```

(Z is used to indicate archive permission in this example.)

If the `Permissions` file is missing, the security software will report that no access permissions are to be granted for the requested object.

5.5.22 PostInstall

Most of the work required to install segments is performed by the COE installation software through information contained in the descriptor directory. However, additional segment-dependent steps must sometimes be performed. `PostInstall` is an executable, either a script or a compiled program, that segment developers may provide to handle segment-specific installation functions *after* the segment has been copied to disk and installed by the COE. During installation, `PostInstall` may invoke functions (e.g., prompt the user) described in Appendix C.

The `PostInstall` descriptor must *not* do any operations that are performed by the COE installation software. For security reasons, the `PostInstall` script is not run with root-level privileges unless the `$ROOT` keyword is given in the `Direct` descriptor. Note that the `$KEY` keyword must also be specified in the `Direct` descriptor before root-level privileges will be granted.

5.5.23 PreInstall

The `PreInstall` descriptor file is identical to `PostInstall` except that it is invoked by the installation software *before* the segment is loaded onto the disk. It must *not* do any operations that are performed by the COE installation software. For security reasons, the `PreInstall` script is not run with root-level privileges, unless the `$ROOT` keyword is given in the `Direct` descriptor. Note that the `$KEY` keyword must also be specified in the `Direct` descriptor before root-level privileges will be granted.

5.5.24 PreMakeInst

`PreMakeInst` is an optional executable program or script that is invoked by the `MakeInstall` tool. It's purpose is to allow a segment to perform "cleanup" operations, before `MakeInstall` writes the segment to the distribution media. Example cleanup operations include:

- deleting temporary files
- ensuring no "core" or other "garbage" files are in the segment
- no compiler "scratch" files, such as temporary intermediate object files.

`MakeInstall` sets the environment variables `INSTALL_DIR`, `MACHINE_CPU`, and `MACHINE_OS` prior to invoking `PreMakeInst`.

5.5.25 Processes

Use the `Processes` descriptor to identify background processes (see subsection 5.9.6). The format of the descriptor is a keyword which identifies the type of process, followed by a list of processes to launch in the form

```
process {parameters}
```

where *process* is the name of the executable to launch, and *parameters* are optional process-dependent parameters. Output from the process is piped to `/dev/null`. For example, suppose `TestProc` is a background process which accepts two parameters, `-t` and `-c`. It will be launched in a manner equivalent to

```
TestProc -t -c >& /dev/null &
```

Valid keywords to identify process type are:

$BOOT	specify a list of processes to launch at boot time
$BACKGROUND	specify a list of background processes
$PERIODIC	specify a list of background processes to run at some specified interval
$PRIVILEGED	specify a list of processes to run in privileged (i.e., "root") mode (available for Unix only)
$RUN_ONCE	specify a list of "one-shot" processes to run the next time the system is started, but only the next time the system is started and never thereafter
$SESSION	specify a list of login session processes
$SESSION_EXIT	specify a list of processes to run prior to terminating a login session

The `$PERIODIC` keyword requires specification of the required interval, in hours. The format is

```
$PERIODIC:hours
```

Executables are assumed to be in the segment's `bin` subdirectory. The `$PATH` keyword can be used to indicate a different location. The syntax for the `$PATH` keyword is

```
$PATH:pathname
```

where *pathname* may be either a relative or an absolute pathname. If the pathname is relative, it is relative to the segment's home directory.

Use of boot-time, background, periodic, privileged, and "one shot" processes requires authorization by the Chief Engineer. Therefore, the $KEY keyword must be specified once, in the form

```
$KEY:Processes:key
```

The authorization key applies to all requests within the `Processes` segment descriptor.

The `Processes` descriptor is a powerful capability the COE provides for managing application processes. Refer to documentation in the Developer's Toolkit for more detailed information on this descriptor.

> **Note:** DCE processes are not described with the `Processes` descriptor. Use the `DCEDescrip` segment descriptor for DCE server-related processes.

5.5.26 Registry (NT only)

The Registry segment descriptor allows segments to add entries to the NT registry. It is followed by a list of keys and filenames, underneath the segment's `data/Registry` subdirectory, whose contents are the key values to add to the registry. `VerifySeg` will generate an error if any of the files listed do not exist.

Consider the following example.

```
[Registry]
$HKEY_LOCAL_MACHINE/SOFTWARE:MyEntries
$HKEY_USERS/DEFAULT:DEFAULT_USER
$HKEY_USERS:ALL_USERS
```

This indicates that files named `MyEntries`, `DEFAULT_USER`, and `ALL_USERS` are located under the directory ***`SegDir`***`/data/Registry` (where *SegDir* is the segment's assigned directory). The contents of these files will be added to the registry under the keys

```
HKEY_LOCAL_MACHINE/SOFTWARE
HKEY_USERS/DEFAULT
HKEY_USERS/<user ID>
```

This capability must be used with great care.

- The installer tools will remove registry entries added with this segment descriptor when the segment is deleted.

- Segment developers shall not create root keys.

5.5.27 ReleaseNotes

Use the ASCII file `ReleaseNotes` to provide information useful to an operator in understanding the new functionality being provided by the segment or the problems being fixed. It is *not* a help file, nor is it information targeted to the system integrator. Therefore, it must not refer to problem report numbers, version numbers, release dates, individuals or companies, point of contact, or similar information. (This type of information is contained elsewhere, such as in the `VERSION` file, and duplication of information may lead to conflicting or confusing information for the operator.) The `ReleaseNotes` file must not contain any tabs or embedded control characters.

An example of a "poor" `ReleaseNotes` file is

```
Release: 5.6.3
Point of Contact: John Doe, Tritron Company
Phone: (619) 555-1234

1. Implemented NCR #302
2. Added check for memory overflow
3. Fixed problem with double scrolling in STR #307
```

An example of a "good" `ReleaseNotes` file is

```
This release fixes two known problems:

(a) Calculation of range and bearing for polar latitudes
has been corrected

(b) Display of garbled latitude/longitude in the Track Summary
display for ownship has been corrected

The following new features are added with this release

1. Search and Rescue TDA added.

2. Option added to restrict operator deletion of comms
messages to only those created by the operator.
```

5.5.28 ReqrdScripts (Unix only)

Use the `ReqrdScripts` descriptor to define the files that establish the runtime environment (account group segment types) or to define files to extend the runtime environment (all other segment types). For account group segments, the syntax is one or more lines of the form:

```
script name:C | L
```

where *C* means to copy and *L* means to create a symbolic link. This flag is used when login accounts are created to either copy environment files to the user's login directory or to create a symbolic link. There can be a maximum of 32 scripts. A script name is restricted to a maximum length of 32 characters.

For example, the `ReqrdScripts` file for the System Administrator account group is

```
.cshrc:C
.login:C
```

The descriptor format for segment types other than account group is slightly different:

```
script name:env ext name
```

where *script name* is the name of a script in the affected account group's `Scripts` subdirectory and *env ext name* is the name of an environment extension file in the present segment's `Scripts` subdirectory.

For example, assume a segment loaded under `/h/TstSeg` with a segment prefix `TST` is to be added to the System Administrator application and it requires extending the `.cshrc` file. The proper `ReqrdScripts` entry is:

```
.cshrc:.cshrc.TST
```

The installation tools will insert the statements

```
if (-e /h/TstSeg/Scripts/.cshrc.TST) then
   source /h/TstSeg/Scripts/.cshrc.TST
endif
```

into the file `/h/AcctGrps/SysAdm/Scripts/.cshrc`. When the segment `TstSeg` is deleted, the installation tools will remove these statements.

Refer to documentation in the Developer's Toolkit for more information.

5.5.29 Requires

Segment dependencies are stated through the Requires descriptor. The format is:

```
[$HOME_DIR:pathname]
segment name:prefix:home dir:[version{:patch}]
```

Segments will not be loaded until all segments they depend upon are loaded. For this reason, the parent segment for an aggregate must *not* list child segments in the Requires descriptor.

The optional $HOME_DIR keyword is used in situations where a segment must be loaded onto the disk in a particular place. This technique should be avoided.

For example, assume the segment TEST must be installed in the directory /home3/tmp/TEST, it requires version 3.0.2 of segment SegA with patches P1 and P4, and also requires SegB version 5.1.1. The Requires descriptor is

```
$HOME_DIR:/home3/tmp/TEST
SegA Name:SEGA:/h/SegA:3.0.2:P1:P4
SegB Name:SEGB:/h/SegB:5.1.1
```

In some cases, it may be possible that a segment dependency can be fulfilled by one or more segments. This is indicated by bracketing such segments with braces and using the keyword $OR between acceptable alternatives.

As an example, suppose the segment TEST above has a dependency that can be satisfied by SegA or the combination of SegB and SegC. The proper Requires descriptor is

```
$HOME_DIR:/home3/tmp/TEST
{
   SegA Name:SEGA:/h/SegA
$OR
   SegB Name:SEGB:/h/SegB
   SegC Name:SEGC:/h/SegC
}
```

Multiple bracketed alternatives may appear in the same descriptor.

> **Note:** The parent segment for a child does not need to be listed in the child's Requires descriptor. By virtue of naming the aggregate parent in SegName, there is an implied dependency.

5.5.30 Security

The `Security` descriptor contains a single entry indicating the highest classification level for the segment (UNCLASS, CONFIDENTIAL, SECRET, TOP SECRET). If the segment contains items with multiple classification levels, the highest classification level must be specified.

> **Note:** This file is used only to determine whether or not software should be loaded onto a workstation. It should not be confused with data labeling or other security features provided by trusted systems.

5.5.31 SegChecksum

The file `SegChecksum` is an optional file created by integration software. It contains information necessary for the System Administrator software to perform an integrity check on the installed software. If the file does not exist, the integrity check cannot be performed on the segment.

5.5.32 SegInfo

`SegInfo` is an ASCII descriptor file which contains segment descriptor information in one or more sections. Table 5-5 lists the possible sections.

5.5.33 SegName

The `SegName` descriptor provides the following information:

- segment type (`$TYPE` keyword)
- segment name (`$NAME` keyword)
- segment prefix (`$PREFIX` keyword)
- segment attributes (`$TYPE` keyword)
- optional aliases for this segment (`$EQUIV` keyword)
- conditional loading requirements (`$LOADCOND`)
- company and product name to add to the registry (NT only)
- if applicable, affected account group, or affected segment for patches (`$SEGMENT` keyword)
- if applicable, name of parent or child segments (`$PARENT`, `$CHILD` keywords)

The keywords `$TYPE`, `$NAME`, and `$PREFIX` are required for each `SegName` descriptor. Additional keywords required depend upon segment type. COE-component segments may not contain `$SEGMENT`, `$PARENT`, or `$CHILD` keywords. All other segments must have one `$PARENT` line, one or more `$CHILD` lines, or one or more `$SEGMENT` lines.

$COMPANY_NAME:*string1* (NT only)
$PRODUCT_NAME:*string2* (NT only)

These two keywords are used for COTS products on NT platforms. They are used to insert a company and product name into the registry. If either keyword is used, both are required. This causes the installer to insert the company name (*string1*) and product name (*string2*) in the registry entry

```
SOFTWARE\company name\product name
```

$EQUIV:*name*:*prefix*

This keyword, which may appear multiple times, allows a segment to define aliases. It is intended to help legacy segments migrate from an earlier COE (e.g., JMCIS or GCCS COE) to the DII COE. It is primarily intended for account group segments, but may be used for other segments as well. *name* is the desired alias and *prefix* is the alias segment prefix.

This keyword allows a segment from a legacy system to be loaded under an equivalent account group without the need to modify the legacy segment's dependency statements. For example, assume that `SegA` was originally developed for JMCIS and that it states in its segment descriptors a dependency on an account group whose name is `JMCIS`. Assume that the legacy segment prefix was `JMC`. Assume that `SegB` was developed for the `GCCS` account group. Finally, assume that `SegA` and `SegB` are to be loaded on a new system under an account group whose name is `New Acct Group` and whose segment prefix is `NAG`. Then the keyword entries

```
$NAME:New Acct Group
$PREFIX:NAG
$EQUIV:JMCIS:JMC
$EQUIV:GCCS:GCCS
```

allow `SegA` and `SegB` to be loaded properly even though they state a dependency on segments, `JMCIS` and `GCCS`, that do not exist in the new system.

$EXCLUDE:*name*:*prefix*:*home dir*

This keyword is used to indicate an account group that a generic segment is to be excluded from. *name* is the name of the account group, *prefix* is the account group's segment prefix, and *home dir* is the assumed location of the account group's assigned directory. This keyword can only be used with segments that specify the GENERIC attribute. The `CharIF` and `RemoteX` account groups are automatically excluded.

$KEY:COE:*key*

This keyword is required for all segments that have the attribute `COE CHILD`, `COE PARENT`, or `WEB SERVER`. *key* is the authorization key obtained from the DII COE

Chief Engineer. For backwards compatibility, existing COE-component segments are "grandfathered" and may omit this keyword for now. However, existing segments should be modified to use this keyword to ensure future compatibility.

$LOADCOND

This keyword, which accepts no parameters, is used to indicate that a child segment in an aggregate is to be conditionally loaded. The child segment is loaded only if the segment does not already exist on the disk or if the child segment is a later version than one already on the disk. If this keyword is used, the segment must also have the CHILD or COE CHILD attribute or else an error is given. This capability is not required for any other type of segment because the installer tool already checks to be sure an earlier version is not unintentionally being loaded over a later version.

$TYPE:*segment type*[:*attribute1*:*attribute2*:...]

where valid *segment types* are

```
COTS
ACCOUNT GROUP
SOFTWARE
DATA
DATABASE
PATCH
```

and valid segment *attributes* are

```
AGGREGATE
CHILD
COE CHILD
COE PARENT
WEB SERVER
WEB APP
GENERIC
```

AGGREGATE is used to indicate that the segment being defined is the aggregate parent segment. It is valid only for account group, data, and software segment types. Aggregates must list one or more child segments with the $CHILD keyword. The COE does not allow an aggregate of aggregates. That is, it is not valid for Aggregate A to have a child B which is also an aggregate.

CHILD is used to indicate that the segment being defined is an aggregate subordinate segment. The parent segment must be listed using the $PARENT keyword.

COE PARENT is used to indicate that the segment being defined is the primary COE segment. Its home directory will be /h/COE.

COE CHILD is used to indicate that the segment being defined is a COE-component segment other than the parent. The installation tools will verify that the segment is an authorized COE component and if not will reject the segment. This is done through the $KEY keyword.

WEB SERVER is used to indicate that this segment is a Web server and a COE-component segment.

WEB APP is used to indicate that this segment is a Web-based application segment.

GENERIC is used to indicate that this is a generic segment that should be added to the account groups as described in subsection 5.4.10.

Segment types are mutually exclusive; only one segment type may be given. Segment attributes are also mutually exclusive, except for Web and GENERIC attributes as follows:

- WEB SERVER may be combined with AGGREGATE, or CHILD.
- WEB APP may be combined with AGGREGATE, CHILD, or COE CHILD.
- GENERIC may be combined with all other attributes except WEB SERVER and COE PARENT.

For example, a generic Web mission application that is a child component of an aggregate would be expressed as

```
$TYPE:SOFTWARE:CHILD:WEB APP:GENERIC
```

The order in which attributes are listed is unimportant.

$NAME:*name*

where *name* is a string of up to 32 alphanumeric characters. Embedded spaces may be used for readability, but the string must not contain tabs or other control characters.

$PREFIX:*prefix*

This keyword establishes the segment's assigned prefix, *prefix*.

$SEGMENT, $CHILD, $PARENT

The syntax for these three keywords is the same.

```
keyword:name:prefix:home dir
```

The descriptor file may contain one and only one $PARENT keyword. Multiple affected segments or child segments may be listed by listing each segment on a separate line.

Note: Do not confuse the attribute `CHILD` with the `$CHILD` keyword. The `$CHILD` keyword is used to indicate a list of subordinate segments in the parent of an aggregate segment. The `CHILD` attribute is used to indicate that a segment is the subordinate segment in an aggregate whose parent is identified with the `$PARENT` keyword.

5.5.34 SharedFile

This segment descriptor handles installation of NT shared DLLs and Unix shared libraries. It is followed by a list of filenames that are the names of the shared libraries (Unix) or DLLs. They must be located in the segment's `bin` subdirectory, which is the DII-compliant location for shared files. `VerifySeg` issues an error message if a filename listed does not exist under the segment's `bin` subdirectory. Shared files must use the segment prefix naming convention to assure that the names are unique.

At installation time, the segment installer copies the shared file to the directory `/h/COE/Shared`, deletes the shared file from the segment's `bin` subdirectory, and then creates a symbolic link from `/h/COE/Shared` to the original location. This is done so that the search path for finding shared files does not need to include any entry other than `/h/COE/Shared`. Segments which have a dependency upon the shared file must identify the segment which provides the shared file in the `Requires` segment descriptor.

Installation requires special care to ensure that a segment which provides a shared library/DLL is not removed when there are segments still installed that require it. For this reason, the installer maintains a usage counter for the shared file. When the segment which "owns" it is installed, the count is set to 1. As segments which depend upon it are installed or removed, the counter is incremented or decremented as appropriate. The installation tools thus prevent the "owning" segment from being removed until the usage count indicates there are no more dependent segments installed.

Shared libraries/DLLs require specific consideration within the COE.

- Segments must state dependencies on the segment providing the shared library/DLL, not the actual file itself.

- One segment may not update a shared library/DLL "owned" by another segment. This would otherwise contradict the fundament COE principle that objects (resources, files, etc.) may be modified only by the segment which owns the object, or by the COE.

5.5.35 Validated

The COE requires strict adherence to integration and test procedures to ensure that a fielded system will operate correctly. To facilitate integration and testing, the `VerifySeg` tool creates the file `Validated` to confirm that a segment has been tested for DII compliance. Subsequent tools in the development, integration, and installation

process use this file to determine whether a segment has been altered, thus indicating that the segment needs to be revalidated.

The following information is captured:

- the version of `VerifySeg` used to validate the segment
- the date and time validation was performed
- who performed the validation
- a count of all errors and warnings produced by `VerifySeg` for the segment
- a checksum computed to enable detection of modifications made after the segment was validated.

5.5.36 VERSION

The format of the `VERSION` descriptor is

```
version #:date[:time]
```

where *version #* is the version number for the segment, *date* is the version date (in mm/dd/yyyy format), and *time* is an optional time stamp (in the format hh:mm). Version numbers must adhere to the rules defined in Chapter 3.

> **Note:** This release of the *I&RTS* extends the year from 2 digits to 4 digits to avoid complications when the year 2000 arrives. `VerifySeg` will issue a warning for any segment that uses less than 4 digits, but since this date is used for documentation purposes only, there is no operational impact if only 2 digits are used.

5.6 Segment Installation

Segment installation requires some form of electronic media (tape, CD-ROM, disk, etc.) that contains the segments, and that has a table of contents which lists the available segments. `MakeInstall` is the tool which creates such electronic media. However, it is important to identify the operations (e.g., compression) performed on segments and the sequence in which these operations are performed.

Installation requires reading the table of contents created by `MakeInstall`, selecting the segments or Configuration Definitions to install, and then copying the segments to disk. Segments may actively participate in the installation process through `PostInstall`, `PreInstall`, and `DEINSTALL` scripts. This subsection details both the `MakeInstall` tool and the installation sequence. At the end of this subsection, detailed information on database creation and deinstallation is presented.

5.6.1 MakeInstall Flowchart

Figure 5-14 shows the sequence of operations performed by the `MakeInstall` tool.

1. `MakeInstall` is given a list of segments that are to be processed. For each segment in the list:

    a) If the segment is not already on disk, it is extracted from the repository and placed in a temporary location.
    b) A check is made to ensure that the segment is a valid segment.
    c) If the segment is invalid, an error message is displayed. If the segment was checked out of the repository and placed in a temporary location, the temporary segment is deleted. `MakeInstall` then terminates.

2. If all segments are valid, a worklist is created. The worklist is sorted to ensure that segments which have dependencies appear in the list *after* the segments they depend upon. This ensures that at install time a tape will not have to be rewound because of segment dependencies.

3. For all segments in the worklist:

    a) Prepare the segment by executing the segment's `PreMakeInst` descriptor if it exists. `PreMakeInst` is prevented from modifying the segment's `SegDescrip`. Otherwise, `PreMakeInst` could invalidate the segment validation step above.
    b) Unless the segment specifies otherwise, all segment subdirectories except `SegDescrip` are compressed.
    c) The compressed segment and its descriptor directory are written out to the specified electronic media.
    d) If the segment was extracted from the repository and placed in a temporary location, the temporary segment is deleted.

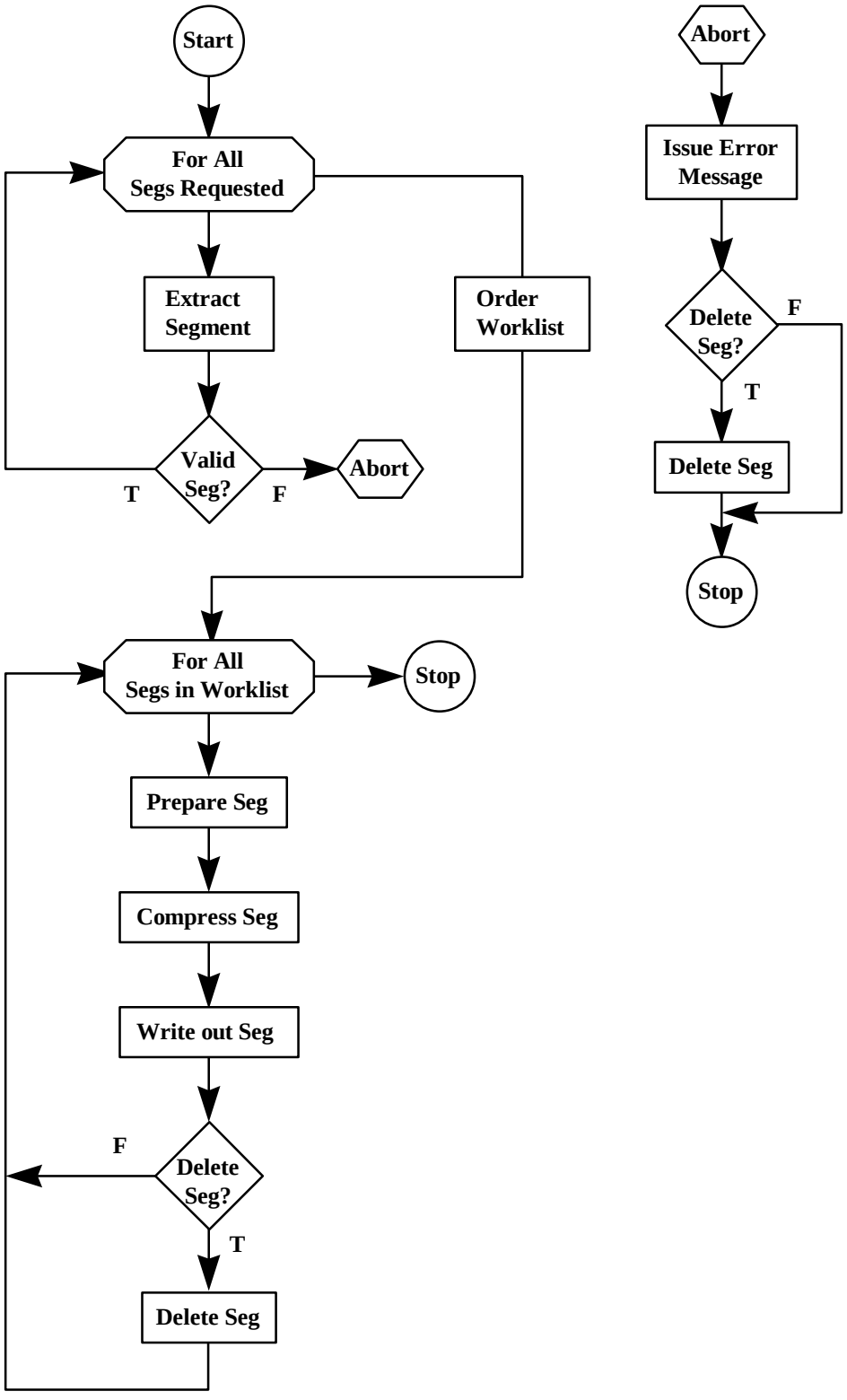


Figure 5-14: MakeInstall Flowchart

5.6.2 Installation Flowchart

Figure 5-15 is a detailed flowchart for the segment installation process. The sequence of `PreInstall`, `PostInstall`, and `DEINSTALL` executions is the most significant aspect of the flowchart. Directives contained in the `Direct` descriptor may affect the sequence (e.g., use of `$REBOOT` and `$ROOT` keywords), but such details are omitted for clarity. The installation software automatically removes patches when a segment is replaced and deletes any temporary space (`$TEMPSPACE` keyword) allocated for the segment. These details are also omitted for clarity.

1. A load device is selected (tape, disk, etc.) and the table of contents created by `MakeInstall` is read.

2. Segments found in the table of contents which do not match the target platform are removed from consideration. Similarly, a check is made to ensure that an operator cannot inadvertently load a segment for which he is not authorized. The environment variables `MACHINE_CPU` and `MACHINE_OS` are set to indicate the hardware platform.

3. The media may have Configuration Definitions defined. If they are defined:

    a) The operator may select a Configuration Definition to load.
    b) If a custom installation is desired, the operator is presented with the table of contents in which all segments in the selected Configuration Definition are highlighted. The operator may add or delete segments from this list.
    c) If Configuration Definitions are not defined, the operator is shown the table of contents and must manually select the desired segments.

4. For all segments selected, a check is made to see if the segment is loadable. To be loadable, all dependent segments must either be selected or already on disk. Conflicting segments must not be selected, nor may they already have been loaded on disk.

5. For all segments selected:

    a) The installation tools determine where to load the segment. The environment variable `INSTALL_DIR` is set to the absolute pathname to where the segment will be loaded. Segments can *not* assume that any environment variables other than `MACHINE_CPU`, `MACHINE_OS`, `SYSTEM_ROOT` (for NT only), `INSTALL_DIR`, and those set to refer to disk space (`COE_TMPSPACE`, `DISK1`, etc.) are defined.
    b) If an old version of the segment already exists on disk, the old segment's `DEINSTALL` script is run.
    c) The new segment's `PreInstall` script is loaded and executed. Note that the new segment is *not* yet on disk.

d) The old segment is deinstalled by the installation tools. Modifications made through the descriptor files are reversed.
e) The old segment is deleted from disk.
f) The new segment is loaded from tape onto disk and decompressed if necessary.
g) The installation tools process commands from the new segment's descriptor files.
h) The new segment's `PostInstall` script is run. `PostInstall` may invoke runtime tools described in Appendix C (e.g., to prompt the user).
i) A status message is displayed indicating whether or not the segment was successfully installed.

6. If any of the segments installed requested a reboot, the operator is notified and asked for confirmation. If the operator confirms, the system is rebooted.

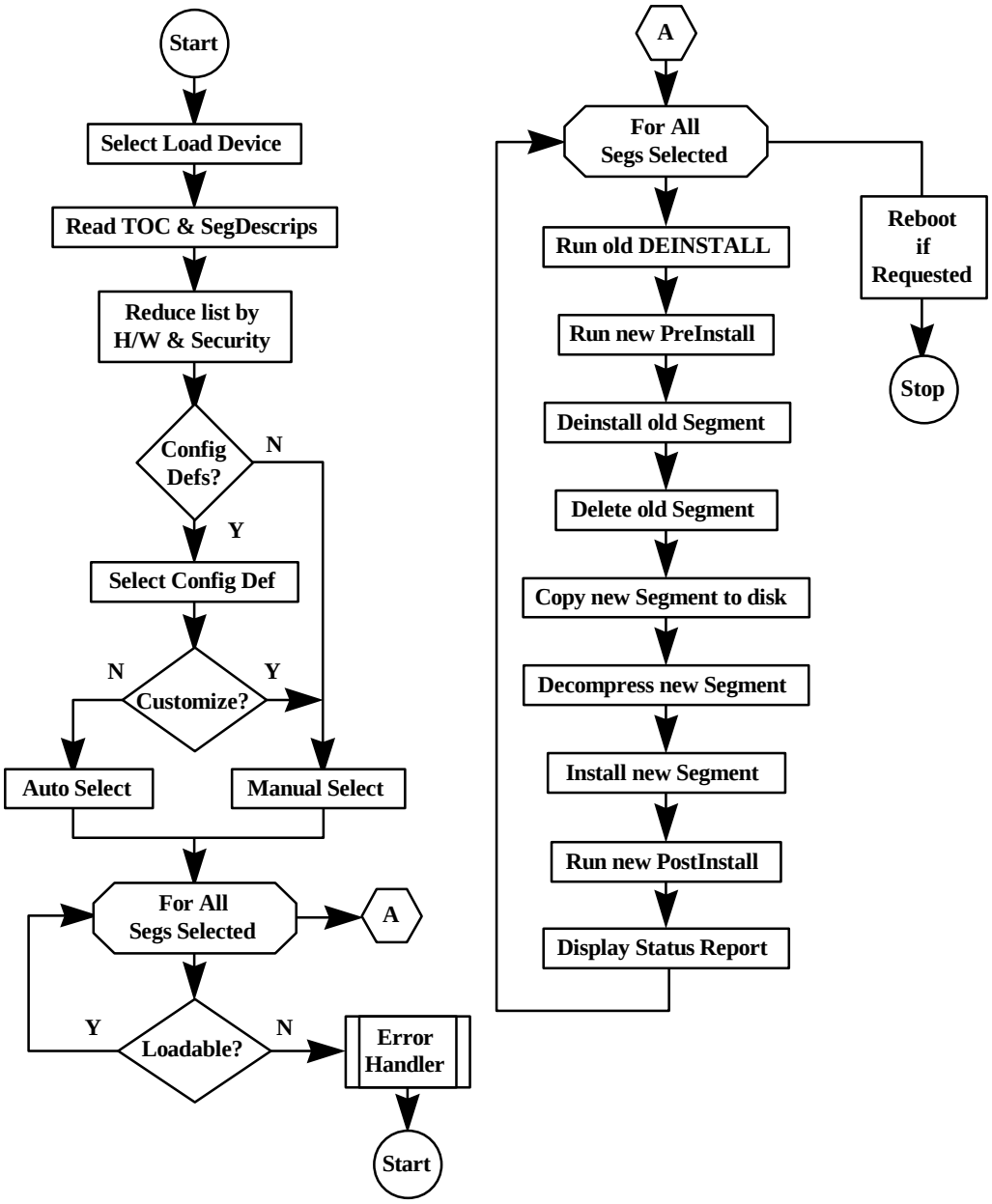


Figure 5-15: Installation Flowchart

5.6.3 Database Installation and Removal

Within the overall installation and removal flowchart presented in Figure 5-15, there are some special considerations with regards to handling SHADE databases. Database installation is described first, then database deinstallation.

5.6.3.1 Database Installation

This subsection describes the installation process flow and how the database segment components work together to install a data store on the COE database server. `PostInstall`, automatically invoked by `COEInstaller`, drives the actual installation and creation of the database and its storage by executing the scripts residing under the install directory of a database segment. The flowchart in Figure 5-16 depicts the process logic of a `PostInstall` file with regards to database segments.

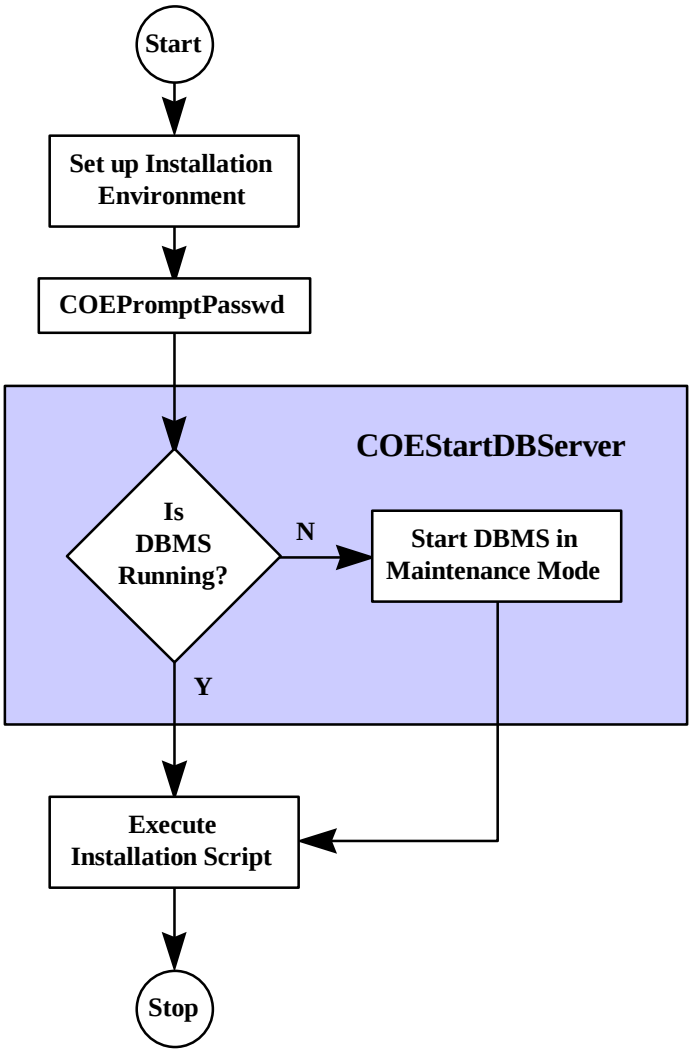


Figure 5-16: PostInstall Logic for DB Install

The DBMS should be operating in its maintenance mode (e.g. Oracle's command `STARTUP DBA EXCLUSIVE`) when a database segment or database patch segment is installed. This prevents users from accessing data objects during their creation and possibly corrupting either the segment or the database instance.

Table 5-6 shows, in broad outline, the sequence of steps performed by a database server segment when it is creating the database. It uses Oracle and Sybase as examples. The first three steps must be performed by a database account with DBA privileges. The owner account (and there may be more than one) should be restricted so it can only create objects in the data stores designated for its use. The remaining steps should be performed by the owning account and should be done without DBA privileges. This ensures that data objects are not inadvertently created in data stores belonging to other databases.

Function	User	Oracle SQL Command	Sybase SQL Command
1. Allocate Storage	DBA	create tablespace ... datafile ...	create database…
2. Create Owner	DBA	create user ...	
3. Create Role(s)	DBA	create role ...	create group …
4. Create Database	Owner	create schema	create table …
5. Load Data	Owner	insert into table	insert into table
6. Create Constraints	Owner	alter table … add constraint	create constraint …
7. Grant Access	Owner	grant ... on table ... to role	grant ... on table ... to group
8. Disconnect Owner	DBA	revoke CONNECT from ...	

Table 5-6: Application Database Creation

1. **Allocate Storage**. This step is performed by the DBA and creates the physical storage needed for the database. Developers shall not assume any particular disk configuration when creating data files and shall create all files in the segment's `DBS_files` subdirectory. Developers may create multiple storage areas (e.g., Oracle tablespaces or Sybase segments) to separate different groups of data objects. Developers shall not modify the core database storage areas.

2. **Create Database Owner**. This step is performed by the DBA and creates the account or accounts that will own the data objects. Their access will be limited to the storage areas created by the segment and to public storage areas (e.g. Oracle tablespace `TEMP` or `USERS`). Owners shall not have access to system storage areas (e.g. Oracle tablespace `SYSTEM`). No permanent objects shall be created in public storage areas by database segments. No objects shall be created in system storage areas. Owners shall not have database administrator privileges.

3. **Create Database Roles**. This step is performed by the DBA and creates the database roles necessary to manage user access. Developers should match the role definitions to the access needed by applications. Developers should not grant privileges that allow users to manipulate the data objects' structure (e.g. Oracle's `Alter` privilege). Users should not be allowed to create their own indexes either.

4. **Create Database**. This step is performed by the Owner and creates tables, views, indexes, constraints, sequences, and any other data objects that are part of the database. If the developer has defined multiple owners, a separate script should be provided for each one. No objects will be created that will be owned by the DBMS default accounts (Oracle's `SYS` or `SYSTEM`, Sybase's `sa`) or by any other account intended to be a DBA. Creation of constraints and indexes may be deferred to speed the data load.

5. **Load Data**. This step is performed by the Owner and fills the data objects previously created. Although index and constraint creation were defined as occurring in the previous step, developers may defer them until the data load is complete to improve performance.

6. **Create Constraints**. This step is performed by the Owner and creates any indexes, constraints, triggers, or other objects that are part of the database but whose creation was deferred until after the data load.

7. **Assign Grants**. This step is performed by the Owner and grants the appropriate access permissions on data objects to the database roles previously defined. Grants shall not be made directly to users accounts. Grants shall not be made to general purpose users (e.g. Oracle's `PUBLIC` user). Only the owner or the DBA are allowed to administer grants. Other users will not be given permissions to further disseminate grants.

8. **Disconnect Owner**. The last step – revoking database connection privileges from the owner upon completion of the load process – is performed by the DBA. It ensures that users cannot connect to the database as the owner of the data and thereby prevents users from modifying schemas, indexes, or grants. Developers shall also require the database administrators to change the password of the owner account upon completion of the database creation.

The flowchart in Figure 5-17 depicts the processing logic of the `install` directory's scripts which drive the creation of the database objects. Each package `install` script executes the database definition scripts that connect to the COE Database Server to create database objects and perform other data definition functions.

The package `install` script executes database definition scripts that actually connect to the COE DBMS Server to create the database objects and perform other data definition functions.

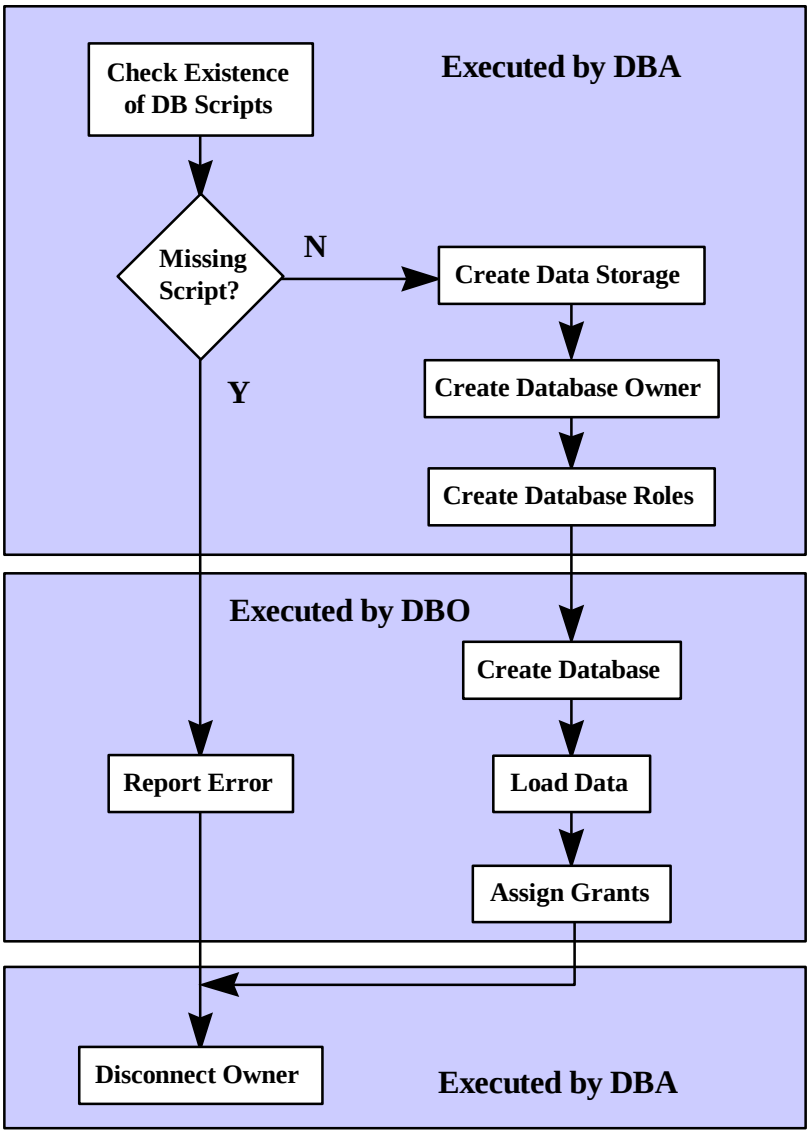


Figure 5-17: Install Scripts Logic

5.6.3.2 Database Segment Deinstall

Deinstallation has a different flavor with databases. First, databases are dynamic. As users make changes to their databases, sites' data sets will diverge from each other. It is unlikely that any two operational sites will have exactly the same data at any point in time. Second, inter-database dependencies restrict the ability to remove segments in a modular way.

However, developers need to provide the capability to remove the application's server segment from the Database Server. This means removing the database and all traces of its presence from within the DBMS and removing all files from the Database Server. The

following steps, at a minimum, must be accomplished. Note that the remove storage step de-assigns the data files from the DBMS, it does not actually remove them from disk. The last step, remove files, is executed from the operating system to delete the data files. Table 5-4 illustrates the logic required, using Oracle as an example.

Function	User	Oracle SQL Command
Remove roles	DBA	drop role ...
Remove objects	owner	drop schema ...
Remove storage	DBA	drop tablespace ...
Remove owner	DBA	drop user ...
Remove files	DBA	N/A (Use OS commands)

Table 5-7: Application Database Deinstall

Within the Oracle server, combining the removal of storage and of data objects by using the Oracle command 'drop tablespace *x* including contents' is not recommended because it tends to overload the DBMS' rollback segments. Developers should use the 'drop schema' command followed by a 'drop tablespace' command instead.

When `DEINSTALL` is being executed to support a segment upgrade or patch, the upgrade or patch must support the deinstall/reinstall of data and supply the scripts to do so.

`DEINSTALL` scripts must be set up to fail nondestructively if other database segments are dependent on the segment to be deinstalled. This can usually be accomplished using the COE Tool `COELstDBDepends`.

5.7 Security Considerations

COE-based systems typically operate in a classified environment. Therefore, the COE and the segment developer both must address security considerations. This section describes the security implications from a runtime environment perspective. It does not address procedural issues such as proper labeling of electronic media, requirements for maintaining paper trails showing originating authority, etc.

Certain restrictions described below are a result of how the operating system manages file versus directory permissions. The most specific permission (i.e., on a file) does not consistently override the least specific permission (i.e., on the file's parent directory).

This section is evolving as security policies are developed for COE-based systems and as legacy systems migrate to the COE. Further guidance will be issued as appropriate. Refer to the DII COE Chief Engineer for specific security concerns or for guidance in segment development beyond the information contained here.

5.7.1 Segment Packaging

Segments shall not mix classification levels within the same segment. It is permissible to create an aggregate that contains segments that are at different classification levels, but the parent segment must dominate the security level of any child segments.

Features that are not releasable to foreign nationals shall be clearly identified through documents submitted to the cognizant SSA when the segment is delivered. Software and data that contain non-releasable features shall be constructed so that the features may be removed as separate segments.

All classified data shall be constructed as separate segments. Developers shall submit unclassified sample data to the SSA in a separate segment for the SSA to use during the testing process.

5.7.2 Classification Identification

All segments shall identify the segment's highest classification level in the Security descriptor. Developers shall submit documentation to the SSA that clearly identifies what features are classified and at what classification level.

5.7.3 Auditing

Segments that write audit information to the security audit log shall include the segment prefix in the output. This is required so that audit information can be traced to a specific segment.

5.7.4 Discretionary Access Controls

Developers shall construct their segments so that individual menu items and icons can be profiled through use of COE profiling software. The profiling software allows a site administrator to limit an individual operator's access to segment functions by menu item and by icon.

5.7.5 Command-Line Access

Segments shall not provide an xterm window or other access to a command-line unless the Chief Engineer grants prior permission. Segment features should be designed and implemented in such a way that operators are not required to directly enter operating system commands. Situations requiring superuser (i.e., root) command-line access shall require the operator to log in as a normal user then use the `su` command (for Unix) to become a superuser. Superuser access by other means is not permitted unless the DII COE Chief Engineer grants prior authorization. Permission will be granted only for COE-component segments.

Segments that provide command-line access shall audit entry to and exit from the command-line access mode. Entry to command-line access mode shall require execution of the system login process so that the user is required to enter a password. For example, the Unix command

```
xterm -exec login
```

will create an xterm window that requires the operator to provide a login account and password.

Segments which require command-line access shall use the `$CMDLINE` keyword (and the required `$KEY` keyword) in the Direct segment descriptor to document that the segment provides command-line access. If the segment provides superuser privileges, the `$SUPERUSER` keyword must also be stated in the `Direct` segment descriptor.

5.7.6 Privileged Processes

Segments shall minimize use of privileged processes (e.g., processes owned by root or executed with an effective root user id). In all cases, privileged processes shall terminate as soon as the task is completed. Privileged processes require prior Chief Engineer approval.

(Unix) The names of the privileged processes must be listed in the `Processes` segment descriptor with the `$PRIVILEGED` keyword. The `$KEY` keyword must also be used to indicate that authorization has been granted by the Chief Engineer.

(Unix) Shell scripts that `SUID` or `SGID` to root are strictly forbidden.

5.7.7 Installation Considerations

Segments shall not require `PostInstall`, `PreInstall`, or `DEINSTALL` to run with root privileges unless permission to do so is granted by the Chief Engineer.

Segments shall not alter the Unix umask setting established by the COE.

5.7.8 File Permissions

Segments shall satisfy at least one of the following two requirements:

1. The segment contains only subdirectories directly underneath the segment's home directory. All files are at least one level down from the segment's home directory.

2. The segment has no directories or files that have the equivalent of the Unix 777 file permissions.

This requirement is an attempt to provide a reasonable balance between security requirements and migration of legacy systems. The main issue is that files and directories should have read/write/execute permissions set for authorized, and only authorized, users.

Segments shall not place any temporary files in the directory pointed to by `TMPDIR` unless deletion, alteration, or examination of such files by another segment or user poses no security concerns.

5.7.9 Data Directories

Segments which contain data items with mixed permissions (e.g., some are read-only, some are write only, some are read/write) shall be split into separate directories underneath the segment's `data` subdirectory (for reasons explained in section 5.7). File permissions on the separate directories shall be set to prevent unauthorized access to data files. No file shall be "world writeable" (i.e., writeable by any user) unless authorized by the Chief Engineer.

5.8 Database Considerations

COE-based systems commonly make extensive use of databases. Database considerations are therefore of paramount importance in properly architecting and building a system. This section provides more detailed technical information on properly designing databases and database applications.

5.8.1 Database Segmentation Principles

A COE database server is a COTS DBMS product. It is used in common by multiple applications. It is a services segment and part of the COE. However, different sites need varying combinations of applications and databases. As a result, databases associated with applications cannot be included in the DBMS services segment. Instead, these component databases are provided in a database segment established by the developer. The applications themselves are in a software segment, also established by the developer, but separate from the database segment. If the data fill for the database contains classified data or is particularly large, that data fill must be in a separate data segment associated with the database segment.

5.8.1.1 Database Segments

The DBMS is provided as one or more COTS segments. These segments contain the DBMS executables, the core database configuration, database administration utilities, DBMS network executables (both server and client), and development tools provided by the DBMS vendor. Databases are provided as database segments. These segments contain the executables and scripts to create a database and tools to load data into the database.

The following functional groupings are used to provide database services. The configuration of COTS segments that provide them may vary depending on the DBMS and the specific configuration chosen by DISA. The COTS segments will usually be provided as a COTS DBMS server segment and a COTS DBMS client segment, installed on the database server platform and on the client workstations, respectively. Specific implementations of COTS DBMS segments are discussed in Appendix F.

1. **DBMS Server**. This functional group provides the DBMS executables, the DBMS's network services executables, and the core database. Its components are usually part of the DBMS server segment.

2. **DBMS Tools**. This functional group provides the executables for other DBMS applications (e.g. Oracle*Forms development tools). Its components are usually part of the DBMS server segment.

3. **DBMS DBA Tools**. This functional group provides the executables for tools used by database administrators (e.g. Oracle's ServerManager). Its components are usually part of the DBMS server segment, but may also be incorporated in the COTS DBMS client segment.

4. D**BMS Client Services**. This functional group provides the client network services for the DBMS and runtime executables for other DBMS applications (e.g. Oracle*Forms 4.0 `runform` executable). Its components are installed on the network's application server and on individual workstations.

The following specific segments are prepared by developers to provide databases within a COE-based system configuration.

1. **Application Database Segment**. This database segment contains a database belonging to a component application. It is installed on the database server.

2. **Application Client Segment**. This software segment contains applications that access a database created by an Application Database Segment. It is installed on the network's application server or on individual workstations.

3. **Application Database Data Segment**. This data segment contains the data fill of a component database when that data fill must be separated from the Application Database Segment. It is installed on the database server.

5.8.1.2 Database Segmentation Responsibilities

Three groups are involved in the implementation of database segments: DISA, the application developers, and the sites' database administrators. The developers and DISA work together to field databases and associated services for the DBAs to maintain. DISA provides the DBMS as part of the COE. Developers provide the component databases. Sites manage access and maintain the data. Users interact with the databases through mission applications and may, depending on the application, be responsible for the modification and maintenance of data in the databases.

5.8.1.2.1 DISA

DISA provides the core database environment in which the applications' segments will be integrated. The basic functionality provided with that core environment gets the database server ready for developers to add their databases and for the sites' database administrators to add and administer users.

The initial database contains the data dictionary, system workspace and recovery storage, storage for the database component of any vendor tools, and an initial allocation of user workspace and temporary storage. The application servers and client workstations are set up with the DBMS client environment so that users need only execute the environment shell script to be able to connect to the server. Finally, the initial operating system and DBMS accounts are established on the database server for the sites' database administrators.

5.8.1.2.2 Developers

Developers are responsible for providing everything associated with their application's database. Developers must define the owner account(s) for their base data objects. They must define and create the data objects within those owner accounts. Aside from the data proper, developers must determine and define the access levels and privileges that must exist for their segment's database. Database roles must be used to implement the users' access controls to ease the maintenance burden on the DBA.

- Developers may implement specific auditing within their applications and databases, but shall not modify the system's security audits.

- Developers shall provide scripts for the DBA's use to add, modify and remove user privileges.

5.8.1.2.3 Database Administrators

The System and Database Administrators at each site are responsible for creating, modifying, and removing users' DBMS and UNIX accounts using COE Tools. For security and ease of management, a "unitary login" or single account name for each user for both the operating system and the DBMS is being adopted for COE-based system. This means that users cannot use DBMS accounts defined by developers and that developers cannot assume the existence of any particular user accounts except for accounts created by the developer to support DBMS services. It also means, as required by the system Security Policy, that database actions can be traced to the individual user. Security auditing is the responsibility of the sites' DBAs. They are implemented as each site needs using the audit features provided by the DBMS.

A DBA creates users' DBMS accounts as part of the process of granting users access to applications and their associated databases. COE Tools are used to accomplish this. In order for these tools and the grants process to work properly and smoothly, the developers must provide procedures, scripts, and instructions for the DBA's use. Users' access will change over time and few users will have access to all applications. The developers' procedures must support the addition of users and the revocation of users' privileges. Since those privileges correspond to applications or sets of applications, separate procedure scripts must be provided for each application or set. If an application has multiple levels of privileges, then multiple procedures must be provided.

5.8.1.3 DBMS Tuning and Customization

The core DBMS instance is configured and tuned by DISA based on the combined requirements of all developers' databases taken together. Developers provide these requirements during Segment Registration. This allows the DBMS Server segments to be reasonably independent of particular hardware configurations and ignorant of specific application sets. It is not tuned or optimized beyond that.

The final tuning of the DBMS cannot be accomplished until a complete configuration is built and it has an operational load. Developers should provide information into the tuning process, but should not make their applications dependent on particular tuning parameters. Where a non-standard parameter is required for operations, developers must provide that information to DISA so the DBMS services segment can be modified accordingly.

The developers need to communicate any design assumptions and DBMS configuration requirements that must be incorporated in the DBMS set-up. If, for example, developers need any settings in the Oracle `initDII.ora` file that are not the default settings for the current DBMS version, that information needs to be provided to the Chief Engineer early in the integration process for a particular release. Based on the impact of the change, DISA can decide whether to modify the baseline server configuration or to develop a COE DBMS patch segment to accompany the application's database segment and modify the in-place database instance.

Similarly, sizing of system recovery logs, log archiving directories, and users temporary workspace is based on the combination of the requirements of the various applications that use DBMS services. Developers must communicate their minimum requirements for these so that the core DBMS is not set to be too small. Most of the application tools provided by DBMS vendors are incorporated in the DBMS segment in the functional category of Server Tools. To ensure that needed tools are available, developers should advise the Chief Engineer what COTS tools they intend to use when registering the segment. When such tools are used, the developer must identify the dependency under the database application segment's `Requires` descriptor.

- Developers shall not modify the core DBMS instance's configuration. Extensions or modifications of that configuration require the specific approval of the DII COE Chief Engineer and will be implemented by DISA in the COTS DBMS segment.

- If developers modify any of the executable tools (e.g. add User Exits to Oracle*Forms), then the modified version of the tool does not reside with the core database services, but becomes a part of the application's client segment. This prevents conflicts among different modified versions of a core function. The maintenance of that modified tool also becomes the responsibility of the developers.

5.8.2 Database Inter-Segment Dependencies

A key objective of the segmentation approach is to limit the interdependencies among segments. Ideally, database segments should not create data objects in any other schema or own data objects that are dependent on other schemas. However, one purpose in having a Database Server is to limit data redundancy and provide common shared data sets. This means that there will usually be some dependencies among the databases in the federation. This section addresses the management of such dependencies.

The following principles apply when inter-database dependencies exist:

- The database schema within a segment that will own the parent object will create that object.

- The database schema within a segment that will own the child (dependent) object will create that object.

- Database schemas with inter-database dependencies will strive to keep those dependencies in segments separate from the non-dependent portions of the schema.

- The referencing object, not the one that is referenced, owns referential dependencies (e.g. foreign keys). If the only dependencies are referential, separate segments are not needed.

- Schemas retain their autonomy. The developer of a dependency (including referential dependencies) is responsible for maintaining that dependency should other developers change their database schemas.

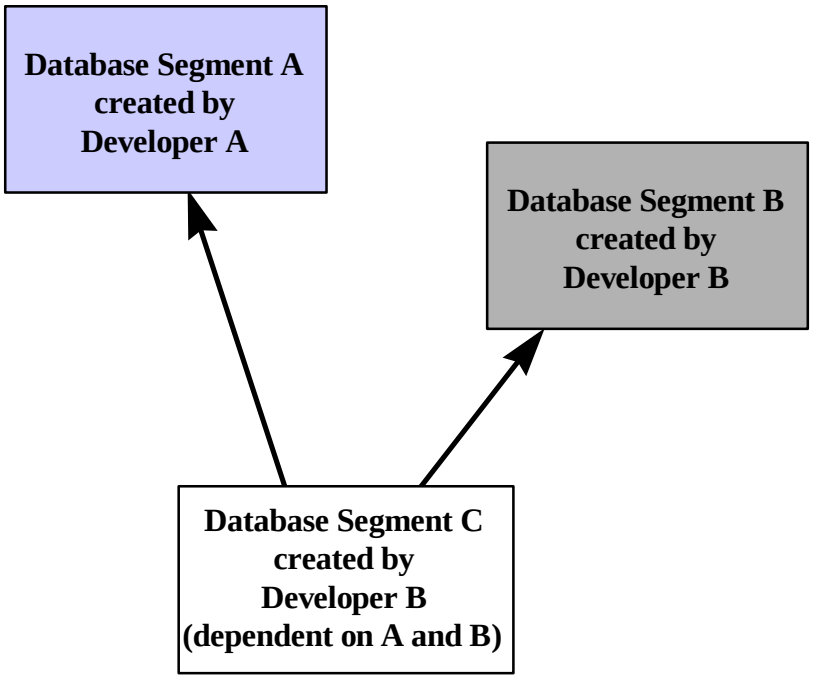
The following are general requirements for database segments.

- Database Segments shall not make modifications to another segment's database. If a schema needs to create data objects in some schema belonging to another segment, those objects will be placed in a Database Segment that modifies the segment that owns those objects. Developers shall not create indexes on another segment's tables because of the performance problems they can cause.

- Developers will not modify the schema of another segment's database. If changes to table or column definitions are needed, they must be effected by the developer of the database.

- When dependencies exist they will be documented under the `Requires` descriptor of the `SegInfo` file. Object dependencies will be document under the `Database` descriptor of the `SegInfo` file.

The following example illustrates (see Figure 5-18) how dependencies are to be created and managed. The developers of database B need to attach a trigger to a table in database A. This trigger will feed data from A to B every time that table is modified. Rather than include the trigger as part of B's Database Segment, it is put into a separate Database Segment C, that modifies Database Segment A. C, the inter-database segment, is dependent on the prior installation of both database segments and is so labeled under its `Requires` descriptor. The table is listed in the `$MODIFIES` section of the `Database` descriptor.



Segment dependencies are listed in the Requires descriptor
Object dependencies are listed in the Database descriptor

Figure 5-18: Inter-Database Dependencies

5.8.3 Loading Data into Database Segments

After the objects belonging to a Database Segment have been created in `PostInstall`, they may need to be populated. Other objects, those containing dynamic data, may be initially empty. Where needed, a database segment can perform initial data fill in the Load Data phase of the `PostInstall`. Several methods are discussed below that can be used to accomplish data loads. Method selection should be based on the amount of data to be loaded.

If a small number of records are to be loaded into a table, the load can be accomplished with insert statements embedded in an SQL command script. The following excerpt is an example for loading data into Oracle.

```
sqlplus -silent DBSORT/${DBO_PWD} <<eof
INSERT INTO SORTSM_BIDES (UIC, SECUR, TIME,SCLAS)
     VALUES ('N00001','U',sysdate,'U');
INSERT INTO SORTSM_BIDES (UIC, SECUR, TIME,SCLAS)
     VALUES ('N00002','U',sysdate,'U');
INSERT INTO SORTSM_BIDES (UIC, SECUR, TIME,SCLAS)
     VALUES ('N00003','U',sysdate,'U');
eof
;;
```

If a large amount of data is to be loaded into a database table, the use of a data loading utility furnished by the RDBMS is usually more efficient. In this case, the utility can be invoked from the LOAD_DATA section of the database definition script. Examples of these data loading utilities are Oracle SQL*Loader, Informix dbload, Oracle or Informix Import, and Sybase bcp. These utilities require that the data to be loaded be stored in a file with a specific format.

Files used for data fill belong in the `data` subdirectory of the database segment. The data directory within the segment can also be used as a 'mount point' for CD-ROM, tape drive, or other bulk storage devices. This is the preferred approach for large data loads. It allows the segment to be filled without occupying disk space during the data fill.

The security classification of the data to be loaded must be considered during the implementation of a database segment. When a classified data fill is part of the database segment, the entire segment becomes classified at the same level as the data. Therefore, developers must separate the data fill from the database segment when the database schema is not classified, but the contents are. The intent here is to keep database segments unclassified as much as possible so schemas can be reused. The security classification of a DII COE system (e.g. GCSS) is a separate issue and is addressed in the security policy of that system's program office.

If a separate data segment is provided to accompany a database segment, that data segment must have a `DEINSTALL` capability. This frees storage after the data fill is complete.

It can take a long time to fill a large database. Developers should indicate the approximate load time in their `ReleaseNotes`. The data load time can be reduced by loading the data before creating the database constraints and indexes. This should only be done with clean data that has been tested against the database constraints.

5.9 Extending the COE

Most properly designed segments will not require any extensions to the COE, except for the need to add icons and menu items. This subsection describes some of the more commonly required extensions, and techniques for addressing less frequently encountered extensions.

5.9.1 Adding Menu Items to the Desktop

Adding menu items is usually required only when installing a software segment. Two pieces of information are required: the name of the affected account group(s) and the menu items to add. Refer to the `SegName` and `Menus` descriptors.

The installation software appends the contents of the segment's menu files to the corresponding menu files in the affected account group(s). This forms a master template in the affected account group's `data/Menus` subdirectory that is subsequently used to create operator profiles. Segments should use the `APPEND` directive in the menu files to add items. Refer to the *Executive Manager Programmer's Guide* in the Developer's Toolkit documentation for the format of menu files.

Previous COE releases included a system menu bar that was displayed at the top of the screen, just below a security banner. The COE no longer automatically provides a system menu bar. Segments that require a system menu bar must use the Executive Manager APIs to explicitly add menu items when the application initializes. Developers may only add menu items that are contained within the current user's profile. The APIs are constructed to prevent addition of menu items to the system menu bar that are not contained in the current user profile.

Segments that use a system menu bar must also use the APIs to remove their system menu bar additions when the application terminates. Refer to the *Style Guide* for guidance on when it is appropriate to use a system menu bar versus desktop icons.

5.9.2 Adding Icons to the Desktop

As with menus, adding icons is usually required only for software segments. Two pieces of information are required: the name of the affected account group and the icons to add. Refer to the `SegName` and `Icons` descriptors above.

The installation software appends the contents of the segment's icon files to a master list located with affected account group(s). This forms a master template in the affected account group's `data/Icons` subdirectory that is subsequently used to create operator profiles. Refer to the Executive Manager API documentation for the format of icon files.

Refer to the *Style Guide* for guidance on when it is appropriate to use a system menu bar versus desktop icons.

5.9.3 Modifying Window Behavior (Unix)

The *Style Guide* defines required window behavior for all segments. X Windows controls window behavior through a collection of resource definitions. The resource definitions consulted are as follows (if they exist):

1. Files located in the directory `/usr/lib/X11/app-defaults`.
2. Files in the directory pointed to by `XAPPLRESDIR`.
3. Resources inherited from the display's root window.
4. The file `$HOME/.Xdefaults`.
5. The file pointed to by `XENVIRONMENT`.

X Windows processes the controls in the order shown, and in such a way that the last control specified overrides any preceding controls.

The COE must carefully control resources to avoid conflicts between segments. Therefore, segments shall *not* place files in directories "owned" by X Windows (e.g., `/usr/lib/X11/app-defaults`.) Instead, segments shall place their resources in the subdirectory `data/app-defaults` underneath the segment directory as shown in Figure 5-2. At install time, the installation tools create a symbolic link underneath `$DATA_DIR/app-defaults` to each of the files contained in the segment. For this reason, segments must use their segment prefix to name all app-defaults used in this manner.

Figure 5-2 also shows that segments may place additional fonts underneath the segment's `data/fonts` subdirectory. At install time, the installation tools create a symbolic link underneath `$DATA_DIR/fonts` to point to each of these files. Segments shall use their segment prefix to name font files used in this way.

The COE establishes the setting for environment variables `XFONTSDIR`, `XAPPLRESDIR`, and `XENVIRONMENT`. Segments shall not modify their value. They are set as defined in subsection 5.3.

Motif follows a similar strategy for setting resources. The COE uses the Motif software provided with the Common Desktop Environment (CDE) software. Refer to the Developer's Toolkit documentation for more details on how Motif operates within the CDE environment.

Segments may *not* place files in any directory "owned" by Motif (e.g., `/usr/lib/X11/app-defaults/Mwm`) or CDE, nor may segments alter the account group's `.mwmrc` resource file, if it exists.

To summarize, for DII compliance:

- Segments shall *not* modify vendor distributed X Windows, Motif, or CDE system resources (`Xdefaults`, `rgb.txt`, etc.).

- Segments shall *not* place files in the X, Motif, or CDE distribution directories (e.g., `/usr/lib/X11/app-defaults`).

- Segments shall use the segment prefix to uniquely name files underneath the segment's `data/fonts` and `data/app-defaults` subdirectories.

- Segments shall *not* modify the COE established setting for `XAPPLRESDIR`, `XENVIRONMENT`, or `XFONTSDIR`.

- Segments shall *not* modify the affected account group's `.mwmrc` file, if one exists.

5.9.4 Using Environment Extension Files (Unix)

The `ReqrdScripts` descriptor allows extensions to the affected account group's "dot" files (`.cshrc`, `.login`, etc.). This is most frequently done to add environment variables. However, unregulated use of environment variables is detrimental to the system. The amount of space the operating system reserves for environment variables is limited and loading a large number of segments could quickly exhaust this scare resource. Each time a process is spawned, the child process inherits environment variables from the parent. Resolving a large number of environment variables can take a significant amount of time and hence degrade system performance.

DII compliance requires adherence to the following guidelines:

- Do not include development environment variables in runtime environment scripts or extension files.

- Use "short names" for environment variables. Unix stores environment variable names as character strings in the environment space, so the longer the variable name, the faster environment variable space is exhausted.

- Reuse environment variables already defined by the COE or affected account group.

- When feasible and efficient, use operating system services (such as pipes and streams) or data files to communicate with other segments, or between components within the same segment.

- Do not use environment variables to communicate control data between components within the same segment. Use operating system services or data files.

- Do not define environment variables that can be derived from other environment variables. For example, to define `MYSEG_BIN` through

```
setenv MYSEG_HOME      /h/MySeg
setenv MYSEG_BIN       $MYSEG_HOME/bin
```

wastes environment variable space. The COE guarantees a predictable directory structure, so `$MYSEG_HOME/bin` can be used directly instead of `$MYSEG_BIN`.

- When feasible, have segment components create environment variables once they begin executing through `putenv` or through "sourcing" a file containing needed environment variables. This approach ensures that segment-specific environment variables are inherited locally by a single segment, not globally by all segments.

5.9.5 Using Community Files

Community files are any files that reside outside a segment's assigned directory. (Data files owned by the segment underneath `/h/data` are considered an exception.) Most required community file modifications are handled automatically by the installation software through descriptor directory files. The `Community` descriptor is used when the installation software cannot provide the modifications required.

All community file modifications are carefully scrutinized at integration time because of the potential for conflict with other segments or the runtime environment. Developers should seek guidance from the Chief Engineer before modifying any COTS community files (those owned by Unix, X Windows, Motif, Oracle, Sybase, etc.).

5.9.6 Defining Background Processes

When an operator logs in, the operating system uses various files to establish a runtime environment context. Segments use the `Processes` descriptor file to add other background processes to the runtime environment.

The COE differentiates between nine different types of processes:

Boot — Processes launched each time the computer is booted or rebooted. Designate boot processes with the `$BOOT` keyword.

DCE Boot — DCE processes launched each time the computer is booted or rebooted. Designate DCE boot processes with the `$DCEBOOT` keyword in the `DCEDescrip` descriptor.

DCE Demand — DCE processes launched on demand by `dced`. Designate such processes with the `$DCEDEMAND` keyword in the `DCEDescrip` segment descriptor.

RunOnce — Processes launched the next time the computer is rebooted. These are "one-shot" processes and are only run the next time the

computer is rebooted, but not for reboots thereafter. Designate RunOnce processes with the `$RUN_ONCE` keyword.

Periodic Processes launched at boot time that run periodically at specified intervals (e.g., 6 hrs, 24 hrs). These processes are equivalent to Unix `cron` process. Use the `$PERIODIC` keyword to indicate these types of processes.

Privileged Processes that require "superuser" privileges to execute. Use the `$PRIVILEGED` keyword to indicate these type of processes.

Background Processes launched the first time an operator logs in after a reboot; these processes remain active in the background even after the operator logs out. Designate background process with the `$BACKGROUND` keyword.

Session Processes launched when an operator logs in and remaining active only while the operator is logged in. Designate session processes with the `$SESSION` keyword.

Transient Processes launched in response to operator selections from an icon or menu. Transient processes typically display a window on the screen, perform some specific function in response to operator actions, and then terminate. In some cases, the processes spawned may stay active for the length of the session, but in all cases, the Executive Manager terminates transient processes when the operator logs out. Designate transient processes through the `Menus` and `Icons` descriptors.

Note: Because of the potential impact to other segments, system performance, and system integrity, all processes except DCE Demand, Session, and Transient processes require prior approval by the Chief Engineer. Boot, DCE Boot, privileged, and periodic processes are *strongly* discouraged.

5.9.7 Reserving Disk Space

Segments frequently require additional disk space to accommodate growth over time as the system operates. For example, communications logs are empty when the system is initially installed, but will occupy space as messages are received and logged. Segments may reserve additional disk space through the `Hardware` descriptor.

The installation software keeps track of how much disk space is actually in use and how much is reserved. A segment will not be installed if the amount of space it occupies, plus any space it reserves, exceeds the amount of unreserved disk space. The installation software allows the operator to select how full the disk can be (80, 85, 90, or 95% of

capacity). These safeguards are in place to avoid filling up the disk, but segments are responsible for detecting when the amount of space requested is not available.

In rare situations, segments may require space on multiple disk partitions. See the `$PARTITIONS` keyword for the `Hardware` descriptor.

5.9.8 Using Temporary Disk Space

Segments may require temporary disk space during segment installation and during system operation. The COE provides techniques for accommodating both uses for temporary space.

Temporary disk space may be requested during segment installation through the `$TEMPSPACE` keyword in the `Hardware` descriptor. The installation software sets the `COE_TMPSPACE` environment variable to point to the location where temporary space is allocated. This environment variable is defined *only* during segment installation. The installation software automatically deletes all files in this temporary area when segment installation is completed.

The environment variable `TMPDIR` points to a temporary directory that may be used during system operation. However, there is a limited amount of disk space set aside for temporary storage so it must be used sparingly. A better approach is for segments to store temporary data in their own `data` subdirectory.

Segments that use `TMPDIR` must delete temporary files when they are no longer required. For Unix systems, all files in this directory are automatically deleted when the system is rebooted. This is *not* true for NT platforms. All segments, as a matter of good programming practices, should delete temporary files when they are no longer needed.

5.9.9 Defining Sockets

Requests to modify the `/etc/services` file to add sockets is done through the `COEServices` descriptor file. This control point for requests to add socket names and ports helps avoid conflicts between segments. Port numbers in the range 2000-2999 are reserved for COE segments. Segments should avoid creating sockets with port numbers less than 1000 since these are generally reserved for operating system usage.

5.10 Miscellaneous Topics

This subsection discusses a variety of miscellaneous topics that are related to segmentation, use of the DII COE, etc.

5.10.1 Color Table Usage

The COE must carefully control how the color table is used to avoid objectionable "false color" patterns that may appear when mouse focus changes from one window to another. The *Style Guide* gives guidance on what colors to use from a human factors perspective, but it does not provide guidance on how segments are to coordinate such usage through the COE.

This document will be expanded to include guidance for color table usage as the impact of COTS products and legacy applications is evaluated.

5.10.2 Shared Libraries

The COE strongly encourages the use of shared libraries to reduce memory requirements. Developers may create shared libraries (DLLs for NT platforms) through use of the `SharedFile` segment descriptor.

(Unix) Developers should also link to X and Motif shared libraries to reduce memory requirements. The Motif libraries provided by CDE should be used instead of the libraries provided by Motif or some other source. This alleviates the need to maintain Motif shared libraries used both by the desktop (e.g., CDE) and other applications.

5.10.3 Adding Network Host Table Entries

Workstation IP addresses and hostnames are site-dependent. Hostnames in particular are most often selected by the site and usually cannot be predicted in advance. Therefore, segments shall not include any assumptions about a workstation having a specific name or following any particular naming convention, nor make any assumptions about a specific IP address class.

Segments should rarely need to add entries to the network host table. An operator usually establishes such entries through system administration functions. For those situations where a segment must do so, the `$HOSTS` keyword in the `Network` descriptor allows IP addresses, hostnames, and aliases to be added to the network host table. The address may be added to either the local host table, or to the DNS/NIS/NIS+ maintained host table.

Prior permission must be given by the DII COE Chief Engineer to use the `$HOSTS` keyword, and permission will be granted only for COE-component segments. `VerifySeg` will issue a warning for any segment which uses the `$HOSTS` keyword, and a warning if the segment does not include the `$KEY` keyword. A future release will issue an error if the segment does not provide a valid authorization key.

5.10.4 Registering Servers

Servers are registered with the COE through the $SERVERS keyword in the Network descriptor. Only COE-component segments may register servers. Prior permission must be given by the DII COE Chief Engineer to use the $SERVERS keyword. VerifySeg will issue a warning for any segment which uses the $SERVERS keyword and strictly fail the segment if it is not a COE-component segment.

A segment that needs to determine the location of a server may use the COEFindServer function (see Appendix C).

5.10.5 Adding and Deleting User Accounts

Segments are not normally allowed to create operator accounts (e.g., Unix user login accounts). Segments may create system accounts, through the COEServices descriptor, for the purpose of establishing file ownership. Operator accounts are normally added to the system through use of the Security Administrator application. They are customizable by security classification level, by access permissions granted or denied against application objects, and by granting or denying access to menu or icon items. The segment descriptors AcctGroup, Security, Permissions, Menus, and Icons provide these controls.

Figure 5-3 shows that operator accounts may be global or local. This attribute is specified when the operator account is created. If the server that contains operator accounts is down, global operator logins will be unavailable until the server is restored.

Profiles may also be global or local. This attribute is determined when the profile is created. If a global profile is not available at login time (e.g., the server is down), login proceeds but the operator is notified of the problem and the system is placed in a safe state.

Some segments require the ability to perform additional operations when a user account is created, or to perform cleanup operations when a user account is deleted. This is done by using the $ACCTADD and $ACCTDEL keywords in the Direct descriptor. Moreover, the $PROFADD, $PROFDEL, and $PROFSWITCH can be used to perform segment-dependent operations when user profiles are created or deleted, or when a user switches from one profile to another. Due to security implications, these keywords require prior permission from the Chief Engineer and use of the $KEY keyword.

5.10.6 Character-Based Applications

Support for character-based interfaces is provided through the CharIF account group. An account is established for individual users through the same process as all other accounts, but the account is identified as a character-based interface account only. Operator profiles may be set up, but only those segments that support a character-based interface (see the Direct descriptor) are accessible.

The remote user connects to the designated server through a remote login session. Once connected, the user is prompted for a login account and password. A menu of options, such as

```
0) Exit
1) AdHoc Query
2) TPFDD Edit

Enter Option:
```

is presented to the user. The option selected is executed and results are displayed on the user's remote, character-based display.

5.10.7 License Management

The COE contains a license manager to administer COTS licenses. Vendors take a variety of approaches in how they control and administer licenses. For this reason, the techniques for automating license management are still under development and are being handled manually. Refer to the DII COE Chief Engineer for further assistance in creating a segment that requires a license manager.

5.10.8 Remote versus Local Segment Execution

Segments which are remotely launchable are designated by the `$REMOTE` keyword in the `Direct` descriptor. This feature is not currently implemented, but is reserved for future implementation. Developers are encouraged to use the `$REMOTE` keyword and design their segments to account for local versus remote execution. Thus, when this feature is fully implemented, developer segments will be positioned to take advantage of the capability.

5.10.9 Modifying Network Configuration Files

Setting up a network requires modification of several network configuration files to set netmasks, identify subnets and routers, etc. Proper network configuration is essential for proper system operation and performance. For this reason, only COE-component segments may establish network configuration parameters. This is accomplished through the `Network` descriptor file.

Prior approval from the DII COE Chief Engineer is required. `VerifySeg` will issue a warning for any segment that uses the `Network` descriptor and strictly fail the segment if it is not a COE-component segment. Note that the `$KEY` keyword must also be specified to give a valid authorization key.

5.10.10 Establishing NFS Mount Points

NFS mount points are defined through the `$MOUNT` keyword in the `Network` descriptor. Establishing mounted file systems can seriously degrade system performance. Poor design

choices that result in several different mount points can create single points of failure, or result in sequencing problems when the system is loaded or rebooted. For these reasons mount points are restricted to COE-component segments.

Prior approval from the DII COE Chief Engineer is required to create NFS-mounted file systems. `VerifySeg` will issue a warning for any segment which uses the `$MOUNT` keyword and will strictly fail the segment if it is not a COE-component segment. Note that the `$KEY` keyword is required.

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